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Department of Agriculture and Natural Resources
Bureau of Agriculture

Adriano Hernandez, Director of Agriculture

Bulletin No. 32

PLANT PROPAGATION AND FRUIT CULTURE IN THE TROPICS

B

BY

P. J. WESTER, *Agricultural Advisor*

Second Revised Edition

MANILA
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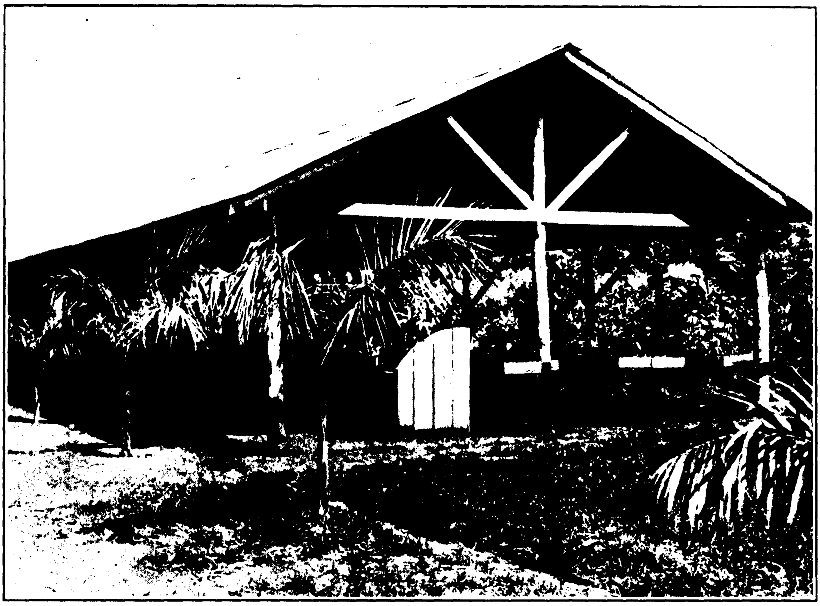
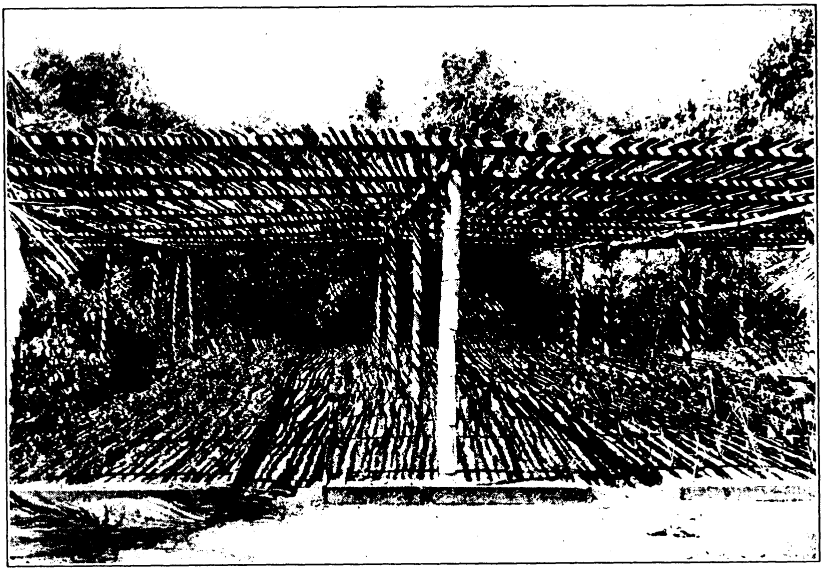


(*a*) Propagation shed, Lamao Experiment Station.



(*b*) Plant shed of bamboo, Lamao Experiment Station.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
Philippine [illegible] BUREAU OF AGRICULTURE

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FOREWORD

This bulletin was first published about three years ago and was translated into Spanish and published in that language in 1918. The steady call for copies has made it seem desirable to publish a new edition in the English language in place of the first which is now out of print.

The present edition of the bulletin has been enlarged and in part rewritten to give it broader scope, and several changes and additions have been made to the illustrations to better elucidate the text.

The chapter containing detailed directions for vegetative propagation of fruits, pages 65–76 has been enlarged very considerably, and some changes have been introduced as the result of data obtained since the preparation of the original manuscript. In its present form it includes various other economic plants in addition to fruits. The planting table has also been revised and enlarged.

The "List of the Tropical Fruits, Spices and Beverage Plants in the Philippines" has been revised and brought up to date and indexed, in the course of which revision the uniform and phonetic system of spelling the dialectal names employed by E. E. Schneider in Bureau of Forestry Bulletin No. 14, "Commercial Woods in the Philippines," 1916, has been adopted so far as it has been possible to ascertain the pronounciation. Except in a few isolated instances where a change has seemed desirable, the standard names adopted in "The Food Plants of the Philippines" (Phil. Agr. Review, Vol. IX, No. 3, 1916) have been retained in the present publication.

PLANT PROPAGATION AND FRUIT CULTURE IN THE TROPICS

INTRODUCTION

In the North Temperate Zone the general opinion in the past has been that the Tropics were not a fit habitation for the Caucasian, that they are infested with deadly diseases, insect pests, poisonous reptiles and other dangerous animals. However, recent explorations, and particularly research relative to tropical hygiene and the treatment of tropical diseases, during the last twenty-five years have done much to clear away this delusion, and have brought about a great change of attitude relative to the inhabitability of the Torrid Zone. Also, it is now generally conceded that those tropical areas in which the white man may not live more or less permanently with impunity are comparatively small, and it has been shown that ability to endure the heat of the Tropics is very largely a matter of proper sanitation and right living. As a result, combined with the increasing need for sugar, copra, rubber, coffee, cacao, tea, textiles, and other tropical products, a development movement in the Tropics has been started within the last score of years to which not even a temporary check can be conceived, and which is destined to continue until few parts of the equatorial belt remain unconquered agriculturally and industrially.

Artificial refrigeration and ventilation have done much to render the Tropics more endurable for those reared in a cooler climate, not to forget rapid transportation, partly through steam navigation, by the means of which one can now be carried from the Tropics to the Temperate Zone in the course of a few days, but still more by the establishment of summer colonies at high altitudes in the Tropics themselves, where one may ascend from the sea coast to an elevation of 1,000 to 2,000 meters in a few hours by rail or automobile. To an even greater extent are distances anihilated by aerial transportation. We may, then, safely predict a steady increase in the white population of the Tropics. This, together with the spread of education, will elevate the standard of living and here as elsewhere the result will be that many things that have hitherto been luxuries will soon be considered necessities, with a greater sense of discrimination relative to quality.

To a certain degree a nation's prosperity and material advance may be estimated by its fruit consumption, and we may assume that as the Tropics are opened to civilization there will be a greater demand for more and better fruits. In addition to this prospective home demand there is already a growing demand for tropical fruits among the wealthy and middle classes of Europe, America and Australia, and if the culture of tropical fruits were more energetically pushed, we should soon see a healthier exchange of tropical for temperature fruits than there is at present and the steamers would return from the Tropics to the great ports of the Temperate Zone laden with other fruits besides bananas and pineapples. Commercially the preservation of tropical fruits and the manufacture of jellies and related products is a rich but hitherto almost unworked field.

However, this state of affairs may not be expected until fruit culture in the Tropics has become, we are tempted to say, revolutionized, the quality of most of the fruits improved, and above all, the standardization of varieties accomplished. Except perhaps in the case of a few more or less herbaceous fruits, like the papaya, cyndra and roselle, this can be brought about only by the means of vegetative propagation, of which it may well be said that *it is the cornerstone upon which rests modern fruit culture.*

The Tropics, with their great numbers of seedling fruit trees and shrubs, may be considered one vast experimental garden. Many of these fruits and plants have some characteristics that render them more desirable than others, such as better flavor and quality, smaller seeds or a lesser number of seeds, better keeping qualities, or they are of an early or a late-maturing habit. But of what value to the people at large is a mangosteen ripening at New Year, a seedless marang or lanzon, a superior mango, or a "papershell" pili, if the individual tree bearing such fruit can not be perpetuated? The virtues of such exceptional trees can be perpetuated and orchards planted only by means of some vegetative method of propagation of the species in question. Furthermore, the best results from the hybridization of related tropical fruits cannot be obtained until the best types of these species have been assembled. It follows that knowledge of asexual means of propagation is absolutely necessary in all perennial plants the improvement of which is contemplated.

The vegetative wealth of the Tropics, including fruits, vegetables and decorative plants, is proverbial, and horticulture is preeminently a tropical pursuit, yet the greatest advances in this art have been made in the colder regions of the earth, though it is interesting to note that much of this advance has been greatly stimulated by the introduction there of plants from the Tropics.

In the Philippines as elsewhere in the Torrid Zone, horticulture has long been neglected, but there are now many signs that indicate a growing interest in this art. It is significant that among the many modern practices of agriculture and horticulture in which instruction has been given by the Bureau of Agriculture through its demonstration and extension division, the demonstrations and instructions in grafting and budding have attracted exceptional interest among the people.

A start toward the improvement of the fruits in the Philippines and their standardization has been made by conducting at the Lamao Experiment Station experiments in vegetative propagation of many species, particularly in shield budding. A beginning has also been made towards the introduction and the establishment of improved varieties in the Archipelago by procuring scions [1] of superior exotic [2] fruits as well as of some of those in the Philippines. It is hoped that this work can be extended and continued until superior, vegetatively propagated varieties of all species are cultivated. This publication is being prepared in the hope that it will serve to popularize better methods of propagation, particularly asexual methods, and better methods of culture of better varieties of tropical fruits.

The publication herein of directions for the vegetative propagation of many species heretofore exclusively propagated from seed has been made possible by the faithful work of Messrs. F. Galang, B. Malvar and S. Capistrano, assistant agricultural inspectors who performed much of the experimental work under the direction of the author. All the plates except XIII*a*, XVIII*b* and XIX, which are published through the courtesy of the Department of Agriculture, Buitenzorg, Java, and XV*b*, XVI and XXI, which are from photographs made by the author, are made from photographs made by Messrs. M. del Castillo and S. Sanchez; the line drawings have been made by Messrs. J. A. Dimayuga and I. L. Miranda. All plates and line drawings illustrating plant propagation have been made from material at the Lamao Experiment Station.

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[1] A piece cut from a plant for grafting or for planting (See "Propagation by Graftage," page 46).

[2] Foreign, belonging to another part of the world.

GENERAL REMARKS

Horticulturally speaking, a nursery is an establishment devoted to plant propagation. It may be small and merely sufficient to supply the needs of the owner, or a commercial undertaking, devoted to plant propagation.

Whether the nursery is large or small the requisites essential for success are the same, barring that of a central location with good transportation facilities. This is an important point to be considered in connection with a commercial venture, but obviously of no importance to him who engages in the pursuit in order to supply his own wants or those of his immediate locality.

In determining the location for a nursery, in districts with a long dry season a place should be selected, if possible, where water for surface irrigation of the nursery fields by flooding is obtainable, where the land is well drained, and where the soil consists of a friable loam rich in humus, underlaid with a clay subsoil. Heavy, sticky soils should be avoided, being difficult to work, and usually baking badly in the dry season. Sandy soils are easily worked, but sandy soil does not adhere so well to the roots of the plants in their transfer from nursery to the field or packing house as does a clayey or loamy soil, and consequently the plants require more care in handling. However, this last requirement mentioned is of greater importance to a commercial nursery than to the homestead, where the plants can be transferred direct from the nursery to their permanent location. Heavy and sticky soils may be improved by an admixture of sand and decayed vegetable matter, and a sandy soil by the addition of clay and well-decayed compost. The land should be well sheltered from the wind; therefore, where there are no natural windbreaks, these should be provided by planting tall and vigorous-growing shrubs and trees on the exposed sides.

It should be kept in mind that in a location having a distinctly dry season for several months, a nursery can not be operated to advantage without irrigation. In fact, it is not good practice to depend upon the natural rainfall even where the conditions in regard to this are unusually favorable.

If the nursery is located near a stream where the water is ample and the fall is sufficient, a small irrigation plant consisting of a tank and a hydraulic ram is the most economical device. If this advantage is absent, recourse must be had to a gasoline, naphtha or steam engine. An engine of 2 horsepower, and a tank with a capacity of 8,000 liters elevated on a tower 6 meters high, is sufficient, unless the establishment is of considerable size, say, with an annual output of more than 50,000 plants. A windmill is inadvisable, partly because in a country where typhoons are practically an annual occurrence they are always liable to serious damage from this source, and a windmill frequently fails to pump the required amount of water when most needed. Unless the piped area is large, a main distribution pipe of 5 centimeters in diameter, with laterals 25 to 37 millimeters in diameter, will suffice. Faucets with threaded spouts to fit an ordinary garden hose (19 millimeters in diameter) should be installed sufficiently near each other, so that all plants can be conveniently watered with the hose. If surface water can be diverted to the nursery in an open ditch, a small nursery may be irrigated with a portable handpump (fig. 11). In order to protect the valves from excessive wear caused by sand and other mineral matter, half barrels should be sunk in the ditch at suitable intervals in which to place the suction hose during the watering.

The above paragraph relates more particularly to the plant shed. The field nursery can be irrigated most economically by means of surface flooding except where the land is excessively sandy. In this connection it is well to remember that level or gently sloping land is more suitable for a nursery than land that is rolling.

The land for the nursery should be thoroughly grubbed to a depth of not less than 30 centimeters, and all trash and stones removed, the land leveled as much as possible and sown to a leguminous cover crop for one year, such as Lyon or velvet beans, cowpeas, Lima beans, guar, or one of the more vigorous varieties of mungo. This will aerate, sweeten and mellow the soil preparatory to the setting out of the plants out in the nursery.

PLANT AND PROPAGATION SHEDS

No one who starts a nursery in the Tropics, no matter how small, should do so without erecting a small plant and propagation shed. The cover of the shed should admit half light, and if it is planned to germinate seed during the rainy season a portion of the shed should be rain-proof, otherwise the losses from the washing out of seeds and plants by the rain, and from damping off, will be heavy. The plant shed will serve to protect the soil in the seed and plant beds from drying out too rapidly and keep the young and tender seedlings from being scorched by the burning midday sun and drying winds. In the rainy season it breaks the force of the heavy rains. A suitable plant shed may be easily and cheaply erected of bamboo (Plate I, *b*).

Ordinarily a glass house is not an indispensable adjunct to a nursery in the Tropics, and, with the exception of those who are engaged in the importation of expensive and delicate plants that are weakened by long transit and which require special care immediately after their arrival, the advantage derived from a glass house, in lieu of a rain-proof shed covered with nipa or corrugated iron (Plate I, *a*), is not sufficient to justify the additional cost incurred in its construction.

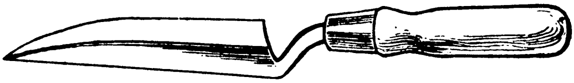


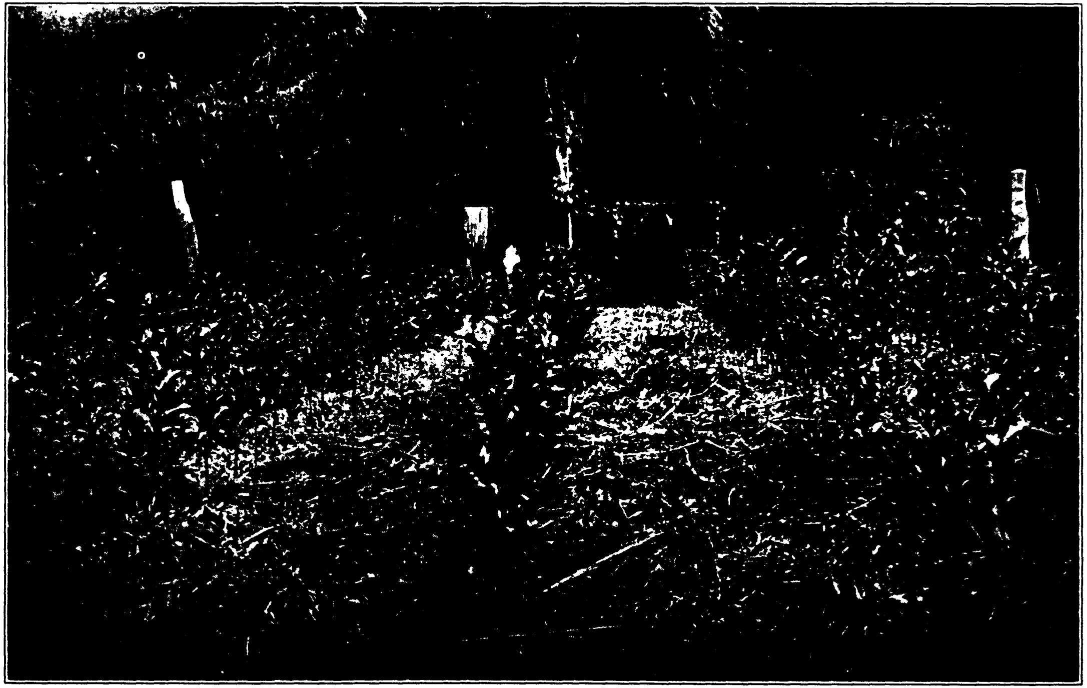
FIG. 1. Trowel

The plant shed should be laid off into beds and paths of a convenient width, so that the laborers can give the plants the needed care in planting, watering, weeding, etc. The beds may be made about 1.5 meters wide and the paths not less than 45 centimeters wide, preferably about 55 centimeters. While this is optional with the operator, the author has found it a good plan to inclose the plant beds with boards about 10 to 13 centimeters broad. The boards are held in place by nailing them to stout stakes driven into the ground. The boards should also be partly sunk into the ground. The soil surface of the bed should be slightly higher than the path in order that the latter may serve to drain off the surplus water during the rainy season by letting the water escape under the boards (Plate I, *b*.)

After the bed has been spaded and prepared for planting, place a wide board across it so that the ends rest upon the boards that inclose it; this is for the laborer to stand upon during the sowing of the seeds or the setting of the plants, and guards against packing of the soil. As the work proceeds, the board is moved forward from time to time.

The rain-proof section of the plant shed should be provided with skeleton benches, made of lumber 5 by 10 centimeters, suitably braced, and about 75 to 80 centimeters high, on which to place the seed boxes, in order that they may be better protected against ants, termites, dogs, etc. (Plate I, *a*). Care

PLATE II.



Section of nursery; pomelo seedling pruned preparatory to budding.

should be taken to see that the benches are level, otherwise, in the course of watering, the water will run to one side of the seed-flat, leaving the rest of the soil dry. The coating of all wood with carbolineum will greatly prolong the life of the structure.

NURSERY ACCESSORIES

SEED-FLATS, IMPLEMENTS, AND TOOLS

Many tools and implements have from time to time been invented and placed on the market the majority of which may be dispensed with. The more indispensable nursery tools are discussed below and these should be found in every well-conducted nursery.

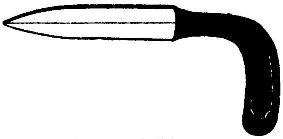


FIG. 2. Dibber

When the plants are propagated on a large scale, they are usually sown in a seedbed, or even planted in rows directly in the nursery, but when small lots of seed are sown, a shallow box, usually called a seed-flat, is frequently preferable. A flat is particularly desirable if the seed is small, or if the plants require more than ordinary care during the early stages.

In the Philippines, the gasoline or kerosene case is perhaps the commonest kind of box, and cut in two, so as to make two shallow boxes, its dimensions are such that it lends itself admirably to the purpose of making a seed-flat (Plate IV, *a*). Unless there is a space of at least 3 to 5 millimeters between the bottom boards, six holes should be bored in the bottom to provide the flat with proper drainage. If seed-flats are made to order, a suitable size is 60 centimeters long, 40 centimeters wide and 10 centimeters deep, inside measurements.

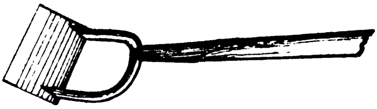


FIG. 3. Scuffle hoe

For small plants in the Tropics, no receptable can compete with the bamboo joint (fig. 19) either for cheapness or availability, and within certain limits it may be made to serve in this capacity until the plants are ready for the field. Where a larger receptacle is needed, a box large enough for all purposes can be made from boards 12 to 15 centimeters wide, and from 25 to 30 centimeters long, with a bottom squared to fit the width of the boards. To provide for drainage, a good-sized hole should be bored in the bottom of the box, while in the bamboo joint a drainage vent may be made by forcing a pointed stick through the bottom.

The spade, hoe and rake are tools well known to all and need only passing mention.

Among the garden tools that are little known in the Philippines and yet of such great convenience that it should be found in the cottage of every one who pretends to do any gardening, is the trowel (fig. 1). Beware, however, of the cheap kind made of pressed soft steel but little thicker than sheet iron, and which often breaks off at the handle at the slightest strain. Insist upon a wrought-iron or cast-steel trowel. The trowel is used in transplanting fairly large plants in the nursery.

The dibber, a stout pointed stick, with or without a bent handle (fig. 2), is another very convenient tool in transplanting small plants.

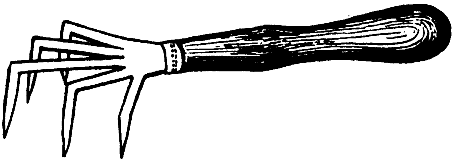


FIG. 4. Weeder

The scuffle hoe (fig. 3) is an implement that is almost unknown in the Philippines, but for weeding purposes it is frequently more efficient than the ordinary hand hoe, particularly on light sandy soils.

A good substitute for a hand weeder (fig. 4) for small plants in the plant beds can be made by shaping one end of a short board, 8 to 10 centimeters wide, to a handle, and driving four or five nails through the other end (fig. 5).

The watering pot (fig. 6) is becoming more and more in evidence throughout the Archipelago.

The pruning knife (fig. 7, *a*) and pruning shears (fig. 7, *b*) are tools that are indispensable in a nursery. There are several kinds of pruning shears. The simplest, strongest and the least liable to get out of order, is the one illustrated and this model should be insisted upon by the purchaser.

The pruning saw (fig. 7, *c*) for the pruning of branches too stout for the shears, should also be among the tools of the up-to-date horticulturist.

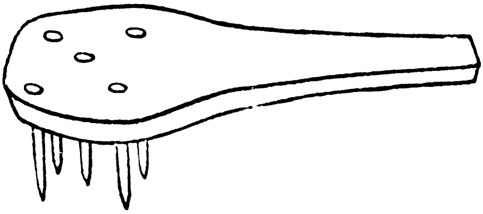


FIG. 5. Homemade weeder

Perhaps there is little use for the grafting tool, but the budding knife (fig. 31, *f*) is indispensable to any one who intends to perform any budding.

In the Temperate Zone, budding and grafting are such every day work for the plant grower and nurseryman, that few stop to think what delicate operations they really are. In fact they are in all respects analogous to surgery in the human species. What constitutes good practice in surgery is therefore equally good practice in budding and grafting. The first requisite is a clean, sharp knife, with a blade as keen as that of a razor. Any one who undertakes to bud or graft with a dull or rusty knife, may well consider whatever success he may have a fortunate exception and not a proof of skill. A small whetstone and a leather strop should be included in the working kit of the worker as he goes to his task. A good test as to the keenness of the knife is to pass it over the forearm. If too dull to shave the hair off smooth, grind and hone the knife until it will do so before cutting another scion.

Finally, no one who grows any considerable number of plants

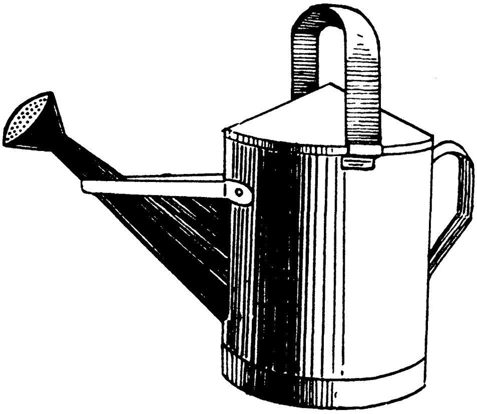


FIG. 6. Watering pot

can afford to be without a sprayer to combat insect pests. The handiest and most suitable for the small grower is the compressed-air sprayer (fig. 8). For larger orchards the barrel-sprayer (fig. 9) will be found convenient. Very large orchards require the employment of power sprayers.

GRAFTING WAX AND TAPE

Waxed cloth, soft cotton string and raffia fiber are used as tying material in budding and grafting, and are serviceable in the order named. In fact, in the Tropics, raffia should be used only when nothing else is to be had. The author has found waxed cloth, when it is properly prepared, preferable to any other tying material.

The best material for waxed cloth is cheap cotton cloth that tears easily. The wax with which the cloth is saturated is made from equal parts, by weight, of beeswax and resin. The cloth is prepared as follows: Tear the cloth into strips 15 to 20 centimeters wide, and wind these strips tightly on stout iron wire, or upon sticks, until the roll is not more than 5 centimeters in diameter. If the rolls are of greater diameter, the wax penetrates with difficulty to the innermost layers of cloth. In order to prevent the cloth from unwinding, tie a string around each end of the rolls. If the cloth is wound upon wire, the weight of the wire will sink the rolls in the mixture; if upon wood, the rolls should be kept submerged

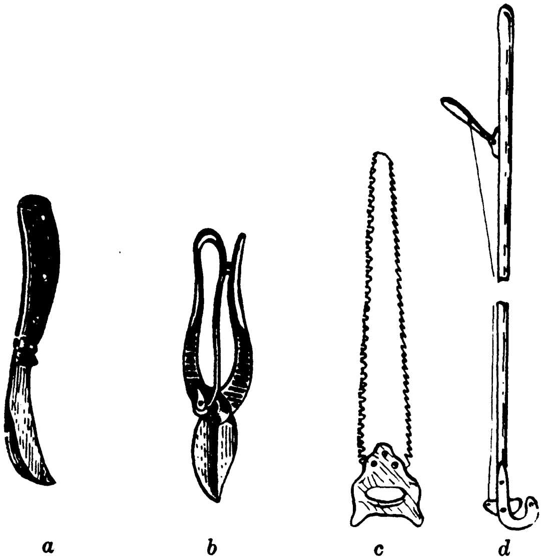


FIG. 7. Pruning tools—(*a*) knife, (*b*) shears, (*c*) saw, and (*d*) tree pruner

until the cloth is saturated with wax. Place the ingredients in an iron pot and melt over a slow fire. Put the rolls of cloth in the melted wax for about 15 minutes. Do not permit the mixture to boil lest the cloth may be burned. When ready to use, unroll the cloth and tear it into strips about 2 centimeters wide (fig. 10). Cooled, the above mixture makes a good grafting wax.

Liquid wax is made by melting one kilogram of grafting wax and adding thereto 0.75 liters of alcohol, mix thoroughly, and keep in a tightly corked bottle.

If twine is preferred to cloth as tying material, procure balls of soft cotton twine, and place them in the melted wax as with the cloth.

PRINCIPLES OF PLANT PROPAGATION

Plants perpetuate and reproduce themselves by means of two methods: (*a*) sexually, or from seeds and spores, which is the method most commonly employed by plants in their wild state, and (*b*) asexually or vegetatively, when reproduction is effected without the aid of the generative organs of the plant, or by the propagation of a growing or vegetative part, such as (1) by means of runners above the ground, as for instance, the strawberry; (2) by underground runners, commonly called ratoons, as in several species of grasses, the pineapple, etc.; (3) by tubers, bulbs, or rootstocks, as for instance the yautia or gabi, and the banana (fig. 12); (4) by stolons,

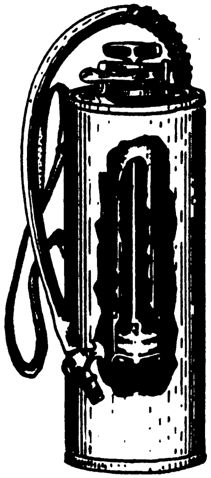


FIG. 8. Compressed air sprayer

such as certain grasses, *Chlorophytum elatum* (fig. 14), etc.; (5) by aerial bulblets, produced in the axils of the leaves, as in several species of *Dioscorea* (fig. 16) or as in the sisal hemp plant in the flower stalks (fig. 13)—in the pineapple the bulblets grow out among the leaf scales immediately under the fruit, when they are commonly called slips (fig. 15); (5) by roots, like the sweet potato; (7) by the formation of germinative tissue, as in certain tubers of the genus *Dioscorea* (fig. 17), or in the leaves of the *Begonia*. These are natural means of propagation.

The propagation of plants by means of cuttings, layering, marcottage, inarching, budding and grafting, also vegetative methods of propagation, is artificial. These methods have been devised by man in his endeavor to propagate certain varieties of fruits, vegetables or flowers, that have originated in the course of cultivation, varieties possessing certain desirable qualities which they are incapable of transmitting to their progeny that it has been found desirable to propagate asexually.

The cereals and most vegetables and ornamental annual plants are propagated from seed. Generally speaking, heredity seems to be most strongly developed in annuals and extreme variation to be present to a lesser degree in them than in many cultivated perennials that have long been domesticated, and which, in order to obtain the best results, it is necessary to propagate vegetatively.

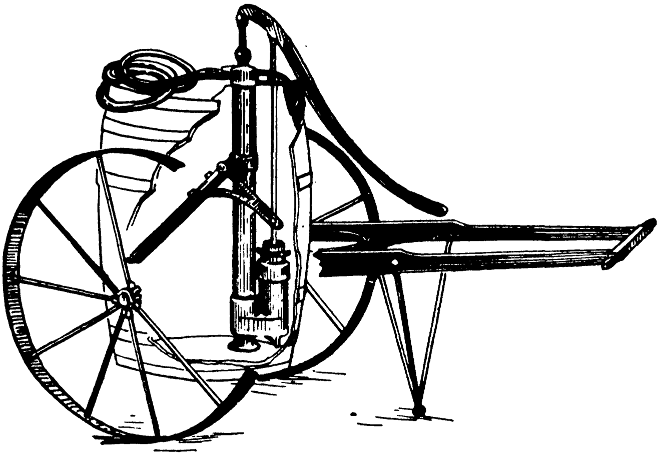


FIG. 9. Barrel sprayer

The four essential factors for successful plant propagation, whether from seeds or cuttings, are a suitable germinative or rooting medium, heat, moisture and air. In a few species, light is also a factor. Of course, a certain percentage of seeds and cuttings will grow even when they are carelessly handled, but it is always good economy to supply everything that is requisite in order to obtain a high percentage of plants and to facilitate their rapid development.

The degree of temperature most favorable for the germination of seeds, or the formation of roots on cuttings, varies with the individual species and is more or less in conformity with the climate of the region to which it is indigenous. No plant growth of any kind can take place without heat. In the Temperate Zone, where much plant propagation is done during the cold months of the year, glass houses are constructed for the purpose, and the necessary heat generated from steam or hot water, and sometimes from electricity. In the Tropics, little or no thought need be given to heat in relation to plant propagation, because of the generally favorable conditions for plant growth in this respect.

FIG. 10. Roll of grafting tape

For practically all seeds, the best germinating medium is a light, sandy soil, fairly rich in humus, the particles of which are easily pushed apart by the tender plant in its endeavor to penetrate the soil to the surface, and which while it is not wet and soggy, does not dry out too rapidly. Seeds of plants that are particularly liable to "damping off," a disease caused by a *Sclerotium* fungus, should be sown on top of the soil in the partly filled flat, and the seed covered with clean sand instead of soil.

Hardwood cuttings are easily rooted in the plant bed in half shade. Softwood cuttings should always be placed in clean, sharp sand.

Water is necessary to promote growth, and it is important that there be no extreme change in the supply of moisture while germination or rooting are under way, or until the plants have acquired a fair amount of vitality and vigor. If, after the seeds have begun to germinate and the cuttings to callus and root, the soil or sand is allowed to dry out, the seed or plant shrivels up and dies, or, if it survives, is stunted. On the other hand, if the soil is kept too wet, the seed rots before the cotyledons appear above the surface, or the tender plant afterwards succumbs to the attack of the damping-off fungus. This disease attacks the tender plant just above the surface of the ground; the plant appears as if it were scalded with hot water, wilts and falls over. The susceptibility of plants to this fungus is very variable, some being very resistant while others quickly succumb.

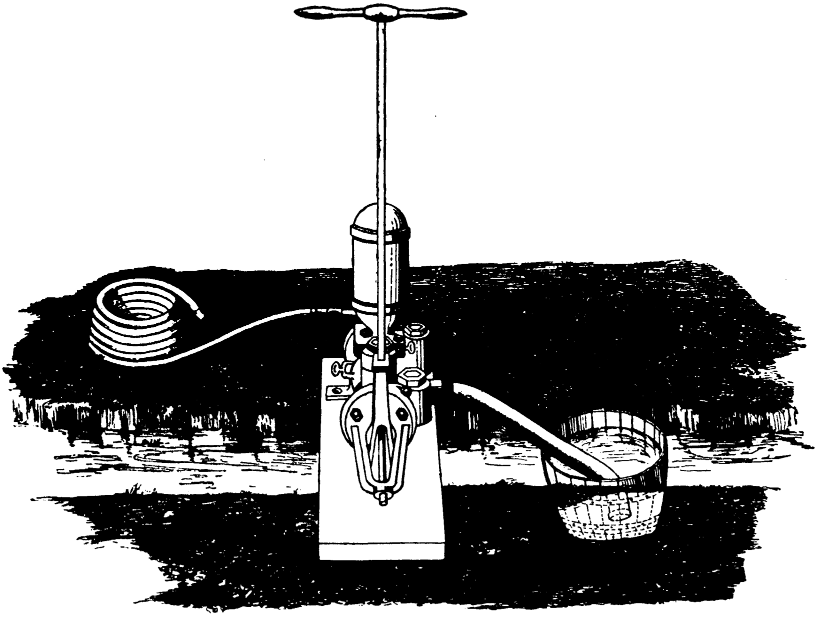
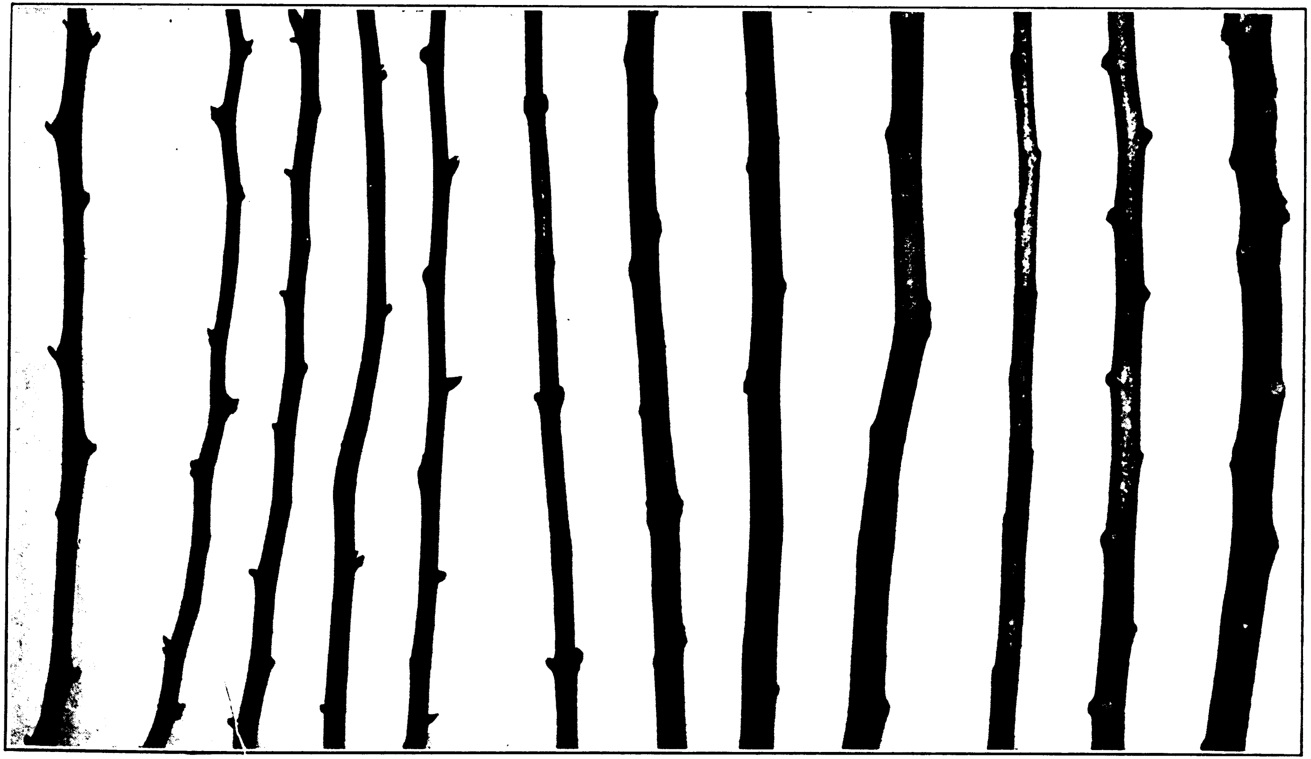


Fig. 11. Hand pump for irrigation

The access of air necessary to plant growth is provided for by the use of a porous soil.

If it is planned to grow the plants in pots or boxes, to be utilized as stocks, pending inarching, grafting or budding, such boxes or pots should be provided in sufficient numbers ahead of the time when they are needed, so that no potting or shifting operations from a small to a larger receptacle are de-



Budwood of various species of tropical fruits. From left to right-petioled budwood of the mandarin, vilatti, tamarind, barobo, carambola and guava; nonpetioled scions of mango, cacao, santol, sugarapple, cherimoya and iba.

layed beyond the time when the plant is ready for the operation. Nowhere is method and system of greater importance than in plant propagation. In most professions and trades, the work may be suspended and taken up again without the subject having suffered any deterioration by the delay. In plant culture this is not so. The would-be successful plant-grower must remember that plants are living things, and that as such they require a certain amount of room, light, air, water and food, and protection from diseases and vermin in order the thrive. The failure to recognize one or more of these needs is responsible for the poor success of many plant-growers and their large losses of plants. Aside from remembering that plants are alive, the grower should also bear in mind that the fact that they are stationary is a further argument for prompt attention to them, inasmuch as they cannot forage for themselves as animals do. In the Tropics, especially, growth continues practically unceasingly, and plants must be provided with more room, water and food as they continue their growth, in order that their development may be healthy and normal. While this is true of plants everywere it refers more particularly to plants that are in pots, boxes, or bamboo tubes. If such plants are not shifted to larger receptacles when their growth demands it, the roots become pot-bound,[1] or pene-

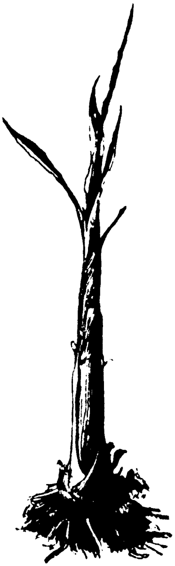


FIG. 12. Banana plantlet

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[1] Compactly matted in a receptacle such as a box or pot.

trate through the drainage vents to the ground, and when the work is finally attended to, the plants are devitalized by the roots having been too cramped, or from their severe pruning in shifting them, and therefore require several weeks before they recuperate and are in condition for budding, etc. It is hardly necessary to say that stunted plants do not take hold and grow so readily after being set out in the field as plants that have received rational treatment.

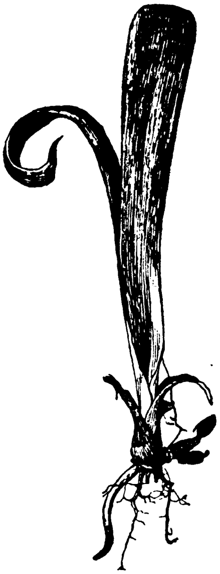

FIG. 13. Maguey bulbil after rooting

PROPAGATION FROM SEED AND THE REARING OF STOCKPLANTS

SOWING THE SEED AND CARE OF THE SEEDLINGS IN THE PLANT SHED

The necessary requisites for successful propagation have already been discussed in a general way on a previous page.

If suitable soil for the seed-flat does not occur naturally, it may be prepared by mixing well-decayed manure, compost or vegetable matter, loam, and rather coarse sand, until a light, friable soil is obtained that crumbles and falls apart under a slight pressure of the hand. Run the whole through a screen to remove all stones, lumps of soil and trash.

Cover the bottom of the flat with a layer, about 1 to 2 centimeters deep, of gravel, small stones, coal ashes, or potsherds, for drainage, and then put in a layer of soil about 8 centimeters deep. Pack the soil moderately firm, and level the surface. According to size, sow the seed in rows 3 to 5 centimeters apart, and 5 to 25 millimeters, or even more, apart in the rows, depending upon the size of the seed and the vigor of the plant. Seeds of species that require more room had better be planted in the seed bed. Care should always be exercised in planting seed never to sow so thick that the seedlings unduly crowd each other and can not be conveniently transplanted. Plants from too thickly sown seeds grow spindly and weak, and easily damp off before they are given more room.

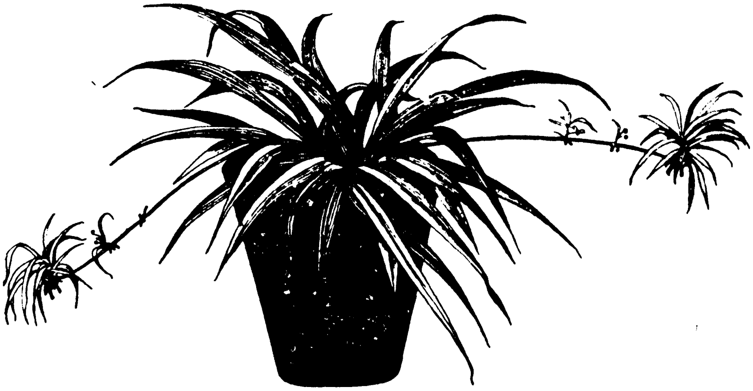

FIG. 14. Plant of *Chlorophytum elatum* illustrating method of propagation

A seed has only a certain amount of reserve nutriment upon

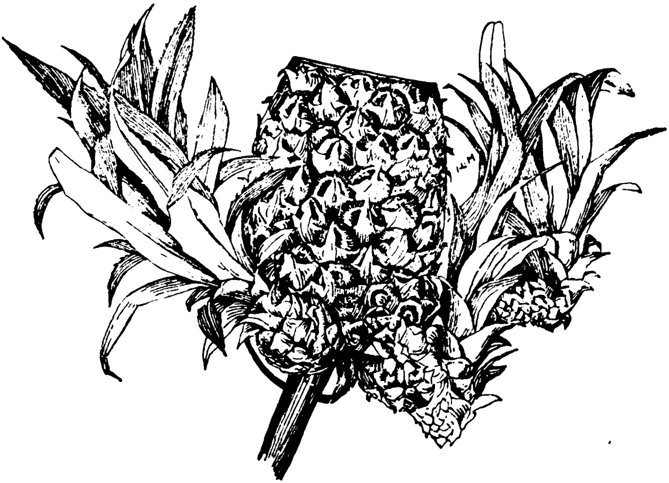

FIG. 15. Section of pineapple showing method of reproduction by slips

which to depend until the plant has pushed through the earth to the surface and is able to take up the plant food in the soil. Therefore, if the seed is planted so deep that the reserve food is exhausted before the plant reaches the surface, it dies of starvation, as it were, even in rich soil. Generally speaking, the seed should be covered with about its own thickness, or a trifle more, of soil.

Here it might be mentioned that contrary to a commonly accepted belief the pili, *Canarium ovatum*, and other related species germinate very readily without resorting to cracking or filing the nut. It is, however, very important that the seed is planted in very light, porous soil and barely covered with soil.

After the seed is planted, water the bed or flat thoroughly; to prevent evaporation, the seedbed may be covered with a light mulch of sawdust or chopped rice straw. Very small seeds should be left uncovered or with barely enough soil sifted over them for a covering.

In such cases the watering of the seed-flats should be done by sub-irrigation. When seed-pans of clay are used as seed-flats, this is done by placing one pan (in which the seeds are sown) in another filled with water which is then gradually absorbed by the soil in the uppermost pan. Where seed-pans of clay are not available seed-flats may be sub-irrigated by the means of bamboo tubes cut about 15 centimeters long, so that the wall between the internodes serves as a bottom for the bamboo tube. Then, with a saw cut through the bamboo tube here and there so that when it is placed in the flat filled with soil the saw-cuts are about 5 centimeters below the surface of the soil. Place 2 to 4 of these tubes in the flat according to the size of the flat and fill the flat with soil, level and sow the seed. Then fill

FIG. 16. Aërial tuber of ubi
Dioscorea alata L.

the bamboo tubes with water, which percolates through the saw cuts and is absorbed by the soil. All subsequent watering of the flat until the seedlings are beyond danger of damping off should be done in the same manner. (Fig. 18.)

Cinchona seed is germinated in darkness, and light is gradually admitted as the plants appear and increase in size. (Plate XIII *a*).

The reasons for maintaining an even moisture content in the seeds bed have already been alluded to and emphasized on page 24.

In order to germinate, many seeds from the Temperate Zones require a certain amount of drying, but in the Tropics, particuarly with fruits, it is exactly the reverse. Unless the seeds of many species are planted at once after they are mature or else preserved in a moist medium, the seed rapidly loses its viability, and even with the best of care it may be preserved only for a short time. Among such species are the mango, avocado, durian, bauno and all species of *Artocarpus*.

If ants and other crawling insects are troublesome, place the seed boxes on a table made of bamboo, with the legs standing in tin cans filled with water or kerosene.

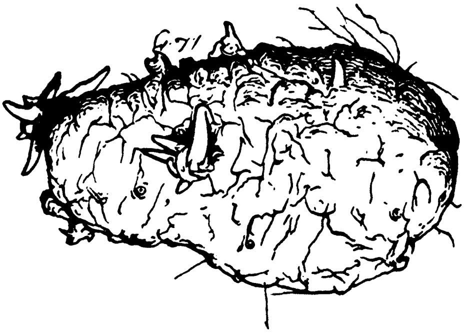

FIG. 17. Subterranean tuber of tongo, *Dioscorea aculeata*, illustrating adventitious germination

In order to prevent the attacks of the damping-off fungus, it is a good rule to allow the plants to dry out to the point of wilting and then water the bed thoroughly. To water a seed-flat or plant bed frequently and lightly is a very harmful practice and one that can not be too strongly condemned, for it encourages the formation of a shallow-root system near the surface and prevents the formation of a normal and deep-going root system, thus stunting the plant.

In those regions which have a distinct dry and rainy season, seed, excepting such as the mango, avocado, bauno, or the durian, from which strong and vigorous plants develop, should never be planted even in a partly covered shed, as the plants are not sufficiently strong to resist the force of the heavy rains which always occur in those regions, and on account of the constant and excessive moisture the danger of damping off is too great. The seed should, therefore, ordinarily, be sown under a rain-proof shed during the rainy season.

As far as this can be done, the sowing of seeds should be timed so that the plants can be transplanted from the seed bed or flat to the plant bed in the bamboo plant shed during the dry season sufficiently early to become fairly well established before the advent of the heavy rains. The average seedling is too weak to transplant during the rainy period. In localities with very heavy rainfall during part of the year, all transplanting, budding and grafting in the nursery should be suspended during the rainy season.

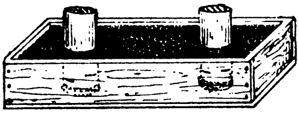

FIG. 18. Seedflat illustrating sub-irrigation

While seeds may be germinated in a dark place, after germination the seed-flat should be moved to a spot where abundant light may be had and yet where the seedlings are not subjected to the direct rays of the sun. If the plants are allowed to grow in a dark place, they become pale, weak and spindly, and are difficult to handle when they reach the transplanting stage.

When the plants have attained such a size as to begin crowding each other, that is, when the leaves begin to overlap, the young seedlings should be transplanted to another bed or flat and given more room. Here, as in the sowing of the seed, the distance at which to place the seedlings should be determined by the vigor of the species in question and the time the plants are expected to remain in their new quarters. Ten to twenty-five centimeters apart each way is a good average distance for ordinary plants. Care should be exercised in watering the seed bed thoroughly before the removal of the plants. Take up the plants with the least possible disturbance of the roots and nip off the tap root before the plants are reset, for this procedure will encourage a better-balanced root system. Always remember that careless and improper handling weakens the plant. It is particularly important that the root system should never be al-

(*a*) One-half of kerosene box utilized as seed flat

(*b*) Herbaceous grafting. Side grafted papaya after union has formed; top of stock partially removed

(*c*) The plant shown in (*b*) two weeks later, top of stock nearly entirely removed

lowed to dry out, and the wilting of the leaves should be kept down to the minimum while the plant is out of the ground. The ideal way is, of course, not to allow the plants to wilt at all. The plants should be set out with the roots in a natural (never in a forced) position (Plate V, *a*) and the soil well packed about the roots. Finally, the plants should be thoroughly watered.

Seed and plant beds should always be kept clean of weeds.

Very robust plants, such as the bauno, mango, etc., the seeds of which were planted far apart, may be transplanted direct from the seed bed to the nursery.

Unless the soil is rich in plant food, it will be found of advantage to fertilize the plant beds from time to time. How much, and how often, will depend upon the appearance of the plants. Manure water, diluted to the color of weak coffee, may be used; likewise lumbang cake[1] dissolved in water is an excellent stimulant, but care should be exercised in its application, for applied in excessive amounts it destroys the plants. A mixture of 36 kilograms dried blood analyzing about 14 per cent of nitrogen, 24 kilograms superphosphate analyzing about 25 per cent phosphoric acid, and 13 kilograms sulphate of potash analyzing about 49 per cent potash, applied dry at the rate of 20 to 25 kilograms per 100 square meters, every three weeks, or when the plants show the need of it, will also be found to produce satisfactory results. Nitrate of soda may be substituted for dried blood, at the rate of 31 kilograms, and low-grade sulphate of potash (26 per cent) at the rate of double the quantity of the high-grade article, 36 kilograms of acid phosphate (16 per cent) may be used instead of the stated amount of superphosphate.

If the soil in the plant bed is deficient in fertility, the above mixture, in the quantities mentioned, may be applied and the thoroughly worked into the soil previous to the setting out of the plants in the bed. Well-decayed manure or compost may also be spaded into the soil to advantage.

TRANSPLANTING TO THE NURSERY

If the plants have received proper care, they will be ready for transplanting to the nursery in the course of a few months, say when they are 25 centimeters or more high.

The plant bed should then be well watered and the tender growth pruned off before the plants are removed. As the plants are dug, cut back the tap root and all long and sprawling roots to within 15 to 20 centimeters of the crown. This root pruning together with the heading back of the tap root at the time of the first transplanting will encourage the formation of a balanced root system well supplied with fine fibrous roots; such a root system holds the soil better and aids the plant in more rapidly establishing itself after the final transplanting from the nursery to its permanent position in the fruit orchard or garden.

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[1] The residue of the seeds of the lumbang nut, *Aleurites moluccana*, after the oil has been expressed.

The necessity of setting out plants with the roots in a natural position at all times and never bent or twisted, cannot be too strongly emphasized. Particularly is this true in transplanting young trees; for if trees are improperly planted they are unable to make a good anchorage and withstand the typhoons that are an annual occurrence in so many parts of the Archipelago (Plate V*a*).

The nursery rows should be laid out 1.2 to 1.5 meters apart, to suit the convenience of the operator, and the plants set 30 to 50 centimeters apart, depending upon the vigor and habit of the species (Plate II). It is a good practice to separate the plants according to their size. If large and small plants are set out together, the larger plants will develop at the expense of the smaller ones and will crowd them. After the plants have been set out, it is well to mulch[1] between the rows in the dry season with straw, grass, etc. During the rainy season it is better not to mulch the plants. Keep down the weeds by frequent and shallow cultivation and be careful not to injure the plants. During the dry season, maintain the plants in constant vigorous growth by close attention to irrigation and the application of artificial fertilizers if the land is poor. With fruit trees in particular, the key to success in both budding and grafting in the nursery and subsequently in the orchard is strong and vigorous stock plants.

PLANTS IN RECEPTACLES

Whenever possible, plants should be reared, budded or grafted in the nursery, unless it is desired to plant the seed "at stake"[2] and to perform these operations in the orchard after the stock plants have become established, which sometimes is advantageous when a species is difficult to transplant after the plant has become of some size. However, it is sometimes necessary to rear the stock in boxes or pots, and bud or inarch them before they are planted in the field. It should be remembered that there is a great difference between keeping a plant merely alive in a box and maintaining it in such a vigorous condition that it can be used as stock. Particularly does this apply to budding, and while there is no intention of discouraging work of this kind, it may be safely asserted that no one who is not well versed in the care of pot plants can grow and bud the stock plants in boxes or any other similar receptacle without meeting with discouraging results, if not a complete failure, which is apt to be attributed to any but the true cause.

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[1] To place any loose material, such as manure, straw, etc., about the trunks or stalks of plants.

[2] By "at stake" is meant planting of the seed in the orchard in the place where the tree is intended to grow permanently.

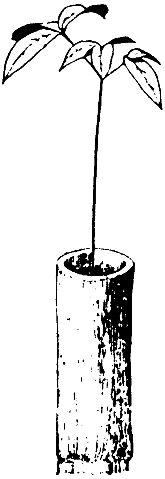


FIG. 19. Bamboo joint used as a plant receptacle

It takes a propagator experienced in this line of work to keep the plants not only in a growing but in a perfectly healthy condition with the sap flowing freely and in a condition for budding. To this end the plant should receive a certain amount of water from day to day, and this only a trained man can rightly gauge. If the plant is over supplied with water, the soil sours, the roots decay and the growth of the plant is suspended; if an insufficient amount of water is given, even for a day, the cambium layer dries up and the bark sticks to the wood as if it were glued; in either case, budding is an impossibility.

In growing plants in boxes, the seed should be germinated in a bamboo tube or in a seedbed, and after it has attained some size, the plant should be transferred to its final receptacle. Before planting, the box should be provided with the necessary drainage by the use of gravel, small stones, etc., to a depth of 2 to 3 centimeters. Ordinarily the plant should be set in the center of the box, but when it is intended for stock for inarching it is better to set it near the edge. Soil similar to that used in the seed bed may be used for potting purposes though a fairly heavy, rich loam is preferable. Pack the soil well around the plant and water thoroughly. For a week or so thereafter water should be given sparingly, until the plant has recuperated from the transfer, otherwise the roots are liable to rot and the plant be stunted. Sturdy plants are obtained only by giving them plenty of room, other conditions being favorable. For the best results, boxed plants should always be grown under the plant shed with half-shade. The plants should be examined every three weeks, if not oftener, and all roots that have grown through the drainage vent cut away. If this is not attended to, the greater part of the root system will soon be found outside of the box. Remember that the more vigorously the plant grows, the more rapidly does it exhaust the available food supply in the box, and the fertility of the soil must be renewed by applications of fertilizer. Where cow or carabao manure is available this may be

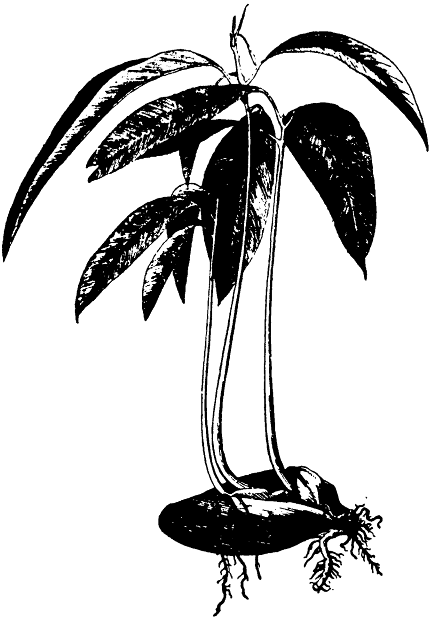


FIG. 20. Mango seedling illustrating polyembryony

washed through a coarse sieve or a piece of gunnysacking into a barrel and diluted until it assumes the color of weak coffee; water the plants with this mixture once every two or three weeks according to their condition, applying about as much as the soil will absorb. Cow manure, however, is not always readily obtainable, and then recourse must be had to artificial fertilizer. Only the most soluble fertilizers should be used, i. e., those that furnish immediately available plant food. The author has for many years used the following formula for many tropical plants, including fruits, ornamentals and palms, applying it at intervals, and in quantities as directed for manure water, with highly satisfactory results:

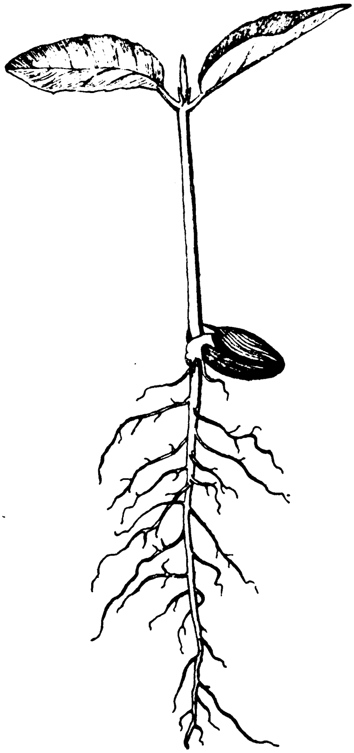


FIG. 21. Seedling of the marang *Artocarpus odoratissima*

Nitrate of soda	grams	275
Sulphate of potash (49 per cent)	do	125
Acid phosphate (16 per cent)	do	350
Water	liters	100

One hundred fifteen grams superphosphate (50 per cent) may be substituted for the acid phosphate, and the high-grade sulphate of potash may be replaced with a double quantity of low-grade sulphate of potash.

Care should be exercised to have the constituents completely dissolved. The acid phosphate has a tendency to settle to the bottom and therefore the solution should be stirred up now and then as the watering proceeds.

PACKING SEEDS FOR LONG DISTANCE SHIPMENTS

In the Temperate Zones practically all seeds may be shipped dry in ordinary paper or cloth bags without impairing their germinability, but in the Tropics the seeds of many species, such

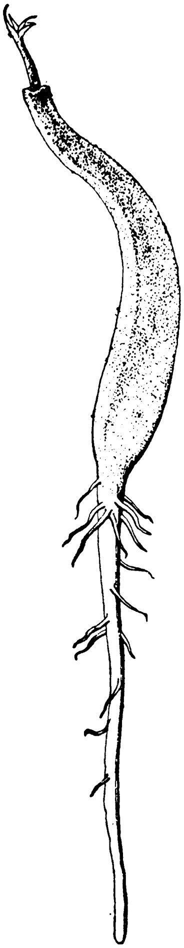
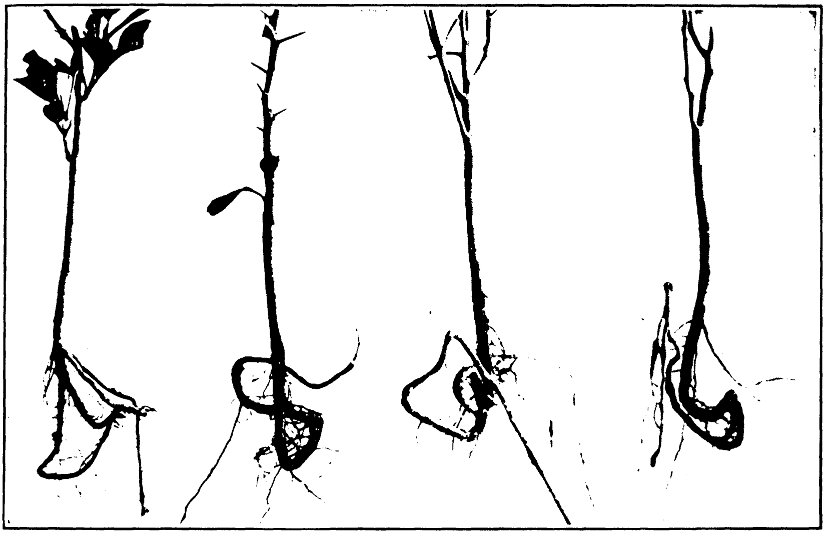
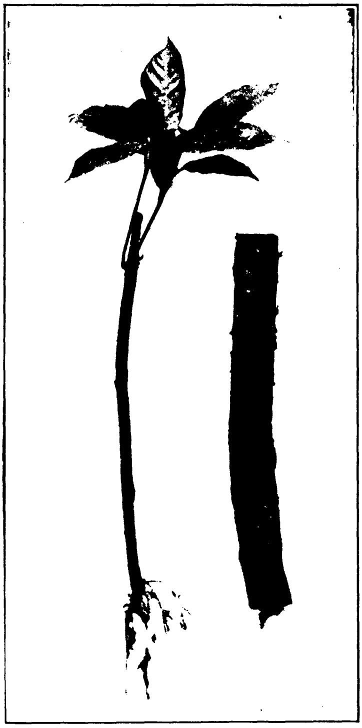


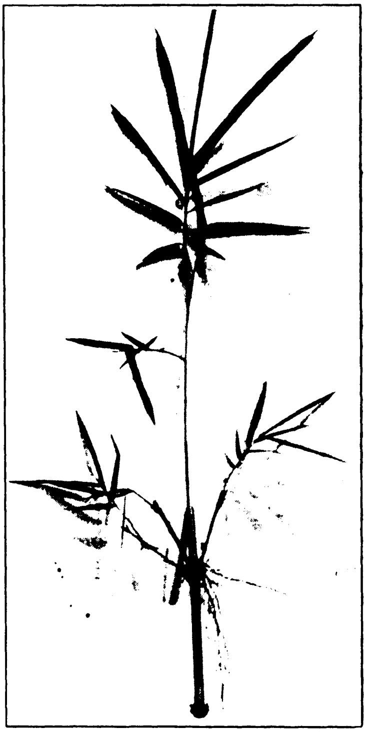
FIG. 22. Seedling of the durian *Durio zibethinus*



(*a*) The result of improper transplanting of seedlings in the nursery



(*b*) Rooted and partially rooted root-cuttings of Rima (seedless bread fruit)



(*c*) Rooted cutting of bamboo

as the durian, mangosteen, avocado, rubber, cacao, tea and coffee rapidly loose their viability if they are allowed to dry out. Therefore, such seeds should be carefully washed free of the pulp, spread out on the floor or blotters, *in the shade,* for from 3 to 4 hours to 2 to 3 days, depending upon the species and the character of the seeds and the moisture adhering to them, the seeds being exposed to drying until no longer wet.

The seeds should then be packed in a tin container in charcoal, coconut fiber, peat dust or sphagnum moss to which just enough water has been added to make the packing medium feel just a trifle moist *but not wet.* The packing medium should not contain any excess moisture for absorption by the seeds as in this case premature germination is induced or, if very wet, the seeds decay.

Fair to good germination may be expected from seeds sown 1 to 3 months after being packed and even longer if the packing was properly attended to.

In territory remote from civilization good packing material is not always available, in which case soil dug from 20 or more centimeters below the surface of the ground, and of proper moisture, will be found a serviceable packing material.

In all cases sufficient packing material should be put with the seeds so that these do not touch and that the tin is completely filled.

If tin containers are not available strong cardboard boxes will do, provided that they are well lined with oiled paper to prevent the moisture from penetrating to the cardboard. Finally the box should be wrapped in strong manila paper.

Seeds that have been long in transit should be planted immediately after their arrival.

PROPAGATION BY CUTTAGE

PRELIMINARY REMARKS

Cuttage is the process of propagating plants from severed parts of plants. The part propagated is called a cutting. Cuttings may be divided into: (*a*) root cuttings, made from the roots; (*b*) stem cuttings, made from the stems or branches of the plant; (*c*) leaf cuttings, made from the leaves. Stem cuttings are again subdivided into: (*a*) softwood cuttings, which are made from tender immature parts of the plants, and (*b*) hardwood cuttings, made from the mature growths.

ROOT CUTTINGS

The roots of certain plants like the mulberry, guava, the citrus fruits and the breadfruit, have the capacity of developing eyes and leaves from the roots, and this fact may be utilized in the propagation of these species. However, in the experience of the author, root cuttings of certain plants are sometimes very capricious in the formation of buds. Until more detailed information has been accumulated relative to this method of propagation, it can not be recommended for general use excepting in the breadfruit. In a limited way, plants may, of course, be propagated by severing a root and pulling the basal end of the root out of the ground; then, as soon as sufficient growth has been made, the plant may be removed to other quarters.

During 1913 a series of experiments with root cuttings of the seedless breadfruit was conducted by the author at the Lamao Experiment Station and the following recommendations are based upon the results obtained, which since have been repeatedly verified.

A plant bed or frame should be filled with clean, medium-coarse, river sand to a depth of 18 to 20 centimeters—beach sand will do provided the salt has been thoroughly washed out. If sand is not procurable, sandy loam may be used.

Larger cuttings may be made, but for the sake of convenience in handling and in order not to impose too severe a strain upon the tree from which the material is obtained, it is inadvisable to dig up the roots for cuttings that are more than 6 centimeters in diameter. Roots less than 1 centimeter in diameter should be discarded.

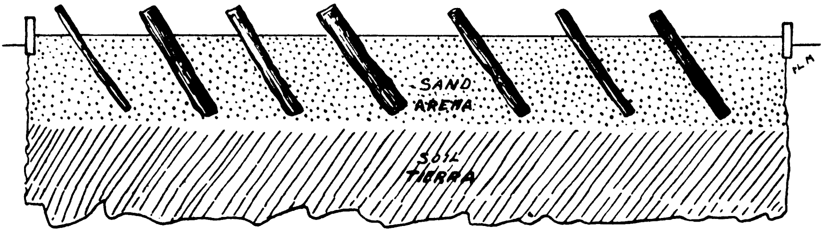


FIG. 23. Root cuttings of the seedless breadfruit inserted in the propagating bed

The roots should be sawed off into lengths of 20 to 25 centimeters each and the ends cut smooth with a sharp knife. The topmost cut should be painted with white lead or coal tar. Then make a trench and place the cuttings diagonally in the sand, leaving about 4 to 6 centimeters of the thickest end of each cutting projecting above the surface, pack the sand well, water, and subsequently treat like hardwood cuttings (fig. 23). When the cuttings are well rooted and have made a growth of from 20 to 25 centimeters, transplant them to the nursery. Great care should be exercised not to bruise, dry, or otherwise injure the material from the digging of the roots to the insertion of the cutings in the sand.

The work should be performed from May to not later than in July, during the rainy season. If they are inserted before the rains begin it is well to spread a wet jute bag over the cuttings during the day to protect them from drying overhead. At night remove the cover.

STEM CUTTINGS

As already stated, stem cuttings are separated into those made from hard wood and those made from soft wood.

Of course, cuttings of some plants root so readily under almost any conditions, provided that they are kept sufficiently moist, that for the rooting of these no particular precautions are necessary. Such cuttings, if made sufficiently early during the rainy season, may be planted in the open where the plants are desired, with the expectation that they will take root and grow without any further attention than weeding. Among such plants may be mentioned: violeta, *Barleria cristata;* the different species of *Acalypha,* madre de cacao; *Gliricidia maculata,* dap-dap; *Erythrina indica,* caturay; *Sesbania grandiflora,* etc.

For such plants as require more care, proceed as follows: Depending upon the amount of sand in the soil, dig out a goodly portion of the soil and replace it with enough clean, medium-coarse sand, so that, when mixed, the soil in the bed contains equal amounts of loam and sand, and a small amount of vegetable matter. The soil should not contain any manure. After the bed is spaded and the sand thoroughly incorporated with the soil, level and pack the soil as hard as possible with a tamper. Then make hardwood cuttings from well-matured growths, about 20 to 30 centimeters in length. The leaves on the basal half of the cuttings should be trimmed off close to the stems, and the butts cut off with a sharp knife, care being taken to avoid bruising. Crushed or bruised ends invite decay and retard or prevent rapid callusing. About two-thirds of the leaves on the upper half of the cutting should also be trimmed off. It is important that at no stage from the time it is cut from the plant to the time the cutting is placed in the ground should the cutting material be allowed to wilt and dry.

Make a trench across the bed with the spade by inserting it into the soil and moving it to and fro until there is a narrow trench just large enough to admit the cuttings. Now insert the cuttings to about two-thirds of their length in a slightly leaning position, about 8 to 10 centimeters apart in the row, and when the row is full, pack the soil thoroughly until they are firmly embedded in the soil. Then make the next trench about 15 centimeters from the first, and so on. After the cuttings are inserted, the bed should be watered thoroughly. It is also beneficial to provide a little extra shading by placing gunnysacking over the bamboo shed above and allowing it to hang down half way to the ground to protect the cuttings from excessive exposure to the sun. As soon as the cuttings have calloused and rooted, remove the gunnysacking. The cuttings should be lightly sprayed morning, noon and night, barely enough to moisten the cuttings, but not enough to keep the ground wet and soggy. Allow the soil to become fairly dry (without of course letting the cuttings wilt) before the bed is again watered, and then soak it thoroughly.

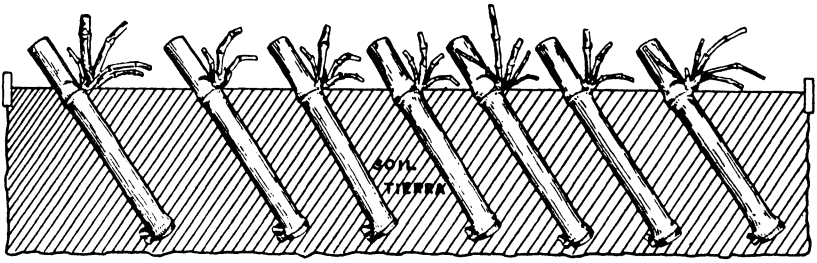


FIG. 24. Transverse section of a propagating bed, illustrating the method of making bamboo cuttings and the manner of their insertion in the bed.

The bamboo has been considered a very refractory subject to propagate from cuttings, but while there is no doubt a great deal of difference in the tractibility of the various species, some of the more common bamboos have been found by the author to root readily, when inserted in sandy soil during the rainy season as already described. (See also page 66 plate V, c and fig. 24). If it is desired to avoid the transplanting of the rooted cuttings, the bamboo should be cut up into lengths of three joints each and inserted into the soil in permanent position as shown in fig. 24 except that both internodes should be underground.

Because of their sappy and succulent character which favors the entrance of fungi, cuttings made from immature growths

(*a*) Shield budded Avocado

(*b*) Shield budded Kamia

(*c*) Shield budded Santol

(*d*) Shield budded Bignay

must be more carefully treated than hardwood cuttings, until their wounds have healed and they have become independent plants. Certain plants like the *Alternanthera, Tradescantia,* etc., are exceptions, and cuttings of these may be planted at once where the plants are wanted, watered, and shaded for a few days (if the work is performed during the dry season), and they will root and grow without the slightest trouble. However, softwood cuttings made from the great majority of species require more attention than this, and should be treated in the following manner; Make a box about 20 centimeters deep and fill it to half its depth with clean, sharp, fresh-water sand. Make the cuttings 5 to 7 centimeters long from the tender, immature, terminal ends of the twigs, preferably so tender that they snap off or break on bending, and trim off about two-thirds of the leaves in the manner illustrated in fig. 25. Insert the cuttings in small trenches made with a flat, wedge-shaped stick, pack the sand around them and water thoroughly. Place the box in a well-shaded, sheltered place and keep the sand constantly moist, but not wet. When the cuttings have rooted, transplant them to another flat or to the plant bed, in light sandy soil.

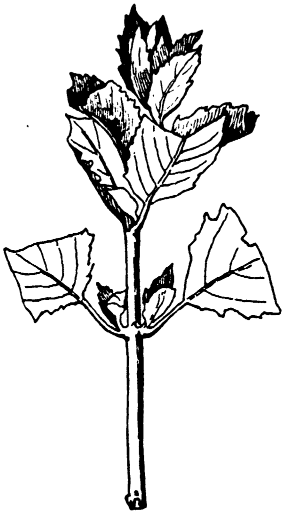


FIG. 25. Softwood cutting

Softwood cuttings are made mainly in the propagation of herbaceous ornamentals, but shrubs may also be propagated in the same manner, for instance *Acalypha; Cestrum, Clerodendron,* etc.

Plants of a succulent nature, such as cacti, *Stapelia*, many species of the genus *Euphorbia*, etc., should be propagated only during the dry season, otherwise they are apt to rot rather than root. Among these may be mentioned the vanilla. Cuttings of this plant should be made 0.75 to 1 meter long, and planted direct in the plantation near the supports. They should not be rooted in the nursery and subsequently planted in the open.

LEAF CUTTINGS

The Sansevieras, Begonias and a few other species possess the remarkable ability to develop germinal tissue from the leaves, and may therefore be propagated from leaf cuttings. In the case of the Sansevieras, cut the leaves in pieces 10 to 15 centimeters long and let them lie exposed to the air in a shady place for two days and then insert them in sandy soil in the plant bed. Do not overwater the cuttings, which should preferably be made during the dry season.

Begonias are propagated by cutting off the large veins on the underside of the leaves, which are then pinned down on the sand in the propagating bed. The leaves may also be cut into small triangular sections, each with a good-sized vein or nerve, and inserted into the sand like a softwood cutting.

Bryophyllum calycinum is also readily propagated from the leaves, these being pinned to the ground; in the course of a few weeks plantlets will grow from each notch in the leaf.

PROPAGATION BY LAYERING AND MARCOTTAGE

Layering may be defined as the rooting of a twig or branch while it is still attached to the parent plant. Marcottage, air-layering, or circumposition, are the names applied to the process when the rooting is made to take place in the top of the parent. For all practical purposes, the plants obtained by this method are equivalent to cuttings. Marcottage is not infrequently employed in the Tropics in the propagation of plants, but layering in the soil is seldom practiced. Most vines are readily rooted by simply laying them in a shallow trench and covering every third or fourth bud with soil. In plants of upright habit, such as shrubs and trees, the lowest branches are bent downward and held in place by a crotch driven into the ground astride the branch. Before the branch is covered with soil it should be notched, or better still, "tongued," at the point where the roots are desired; a small stone or chip of wood should be placed in the cleft to prevent healing (fig.

26). As soon as a sufficient root system has formed for the support of the branch, it may be severed from the parent plant. At the same time, it is well to reduce the top of the branch about a third unless the new root system is well developed.

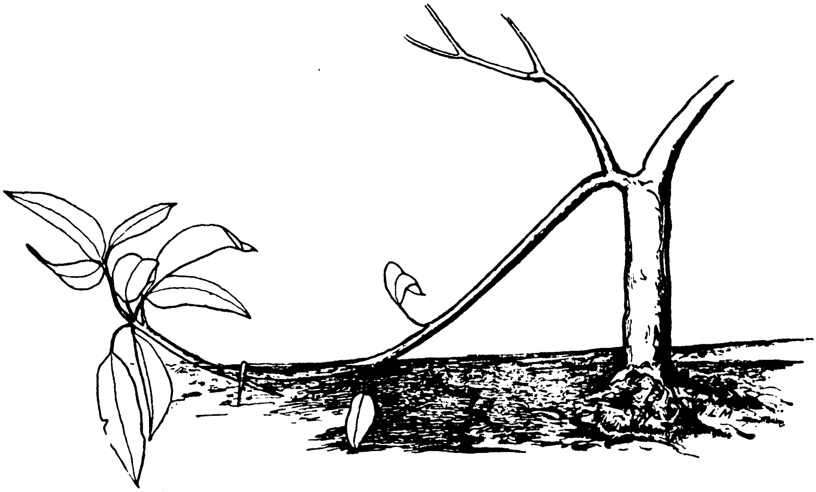


FIG. 26. Layering

Plate XIII *b* illustrates the propagation of the tungulu, by means of layering in the ground, and in flats and bamboo tubes raised above the ground.

As already stated, marcottage is only a modification of layering. There are several variations in the method, of which the following is the best: Tongue the branch to be rooted upwards and place in the cleft a small stick or a piece of coconut fiber; then tie coconut fiber around the cleft as shown in fig. 27. This may of course be done at any time of the year, but if it is done during the dry season, the coconut fiber must be watered from time to time in order to induce rooting. It is therefore advisable to make the marcottage cutting at the beginning of the rainy season, as then it does not require any care whatever. As soon as the roots penetrate to the surface of the coconut fiber, the cutting may be severed and planted in the plant bed, care being taken to remove part of the tender growth and foliage.

PROPAGATION BY GRAFTAGE

PRELIMINARY REMARKS

By graftage is understood the process of the transfer of a part of one plant onto another with the intention that the two shall grow together and all matters pertaining to this operation.

Graftage is an art that was already known to the classical writers and was referred to by Virgil and Pliny. How it originated can only be conjectured. In all probability, inarching was the initial step as the result of the observation of the growing together of two limbs or branches, a not unusual occurrence.

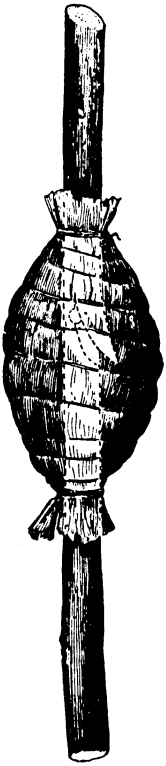
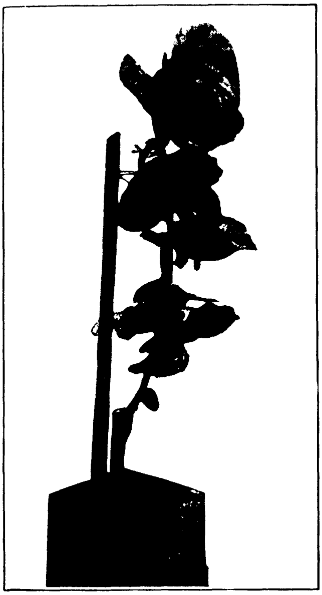


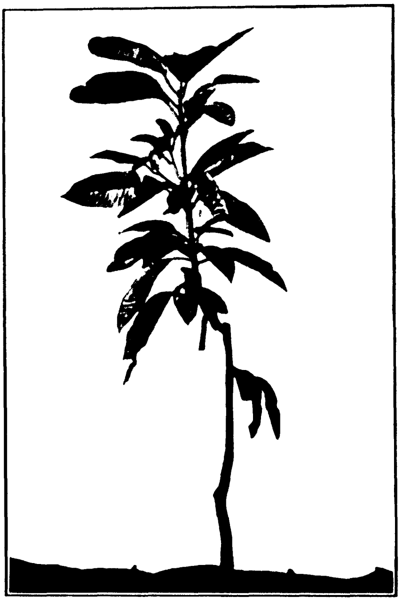
FIG. 27. Section of branch illustrating propagation by marcottage

The chief modes of grafting were well known at least two hundred and fifty years ago, as may be seen from an illustrated publication issued in 1672 by Robert Sharrock, entitled "The History of the Propagation and Improvement of Vegetables."

According to Bailey, 119 variations of graftage were described by a French author in 1831, and it is perhaps safe to say that all methods of grafting that are ever likely to be worthy of attention have already been devised and are more or less in practice. The most that remains for us to do is to modify and adapt the methods already in vogue to suit those species



(*a*) Shield budded Phalsa



(*b*) Shield budded Huani

(*c*) Shield budded Uvero

(*d*) **Biriba shield budded on Guanabano**

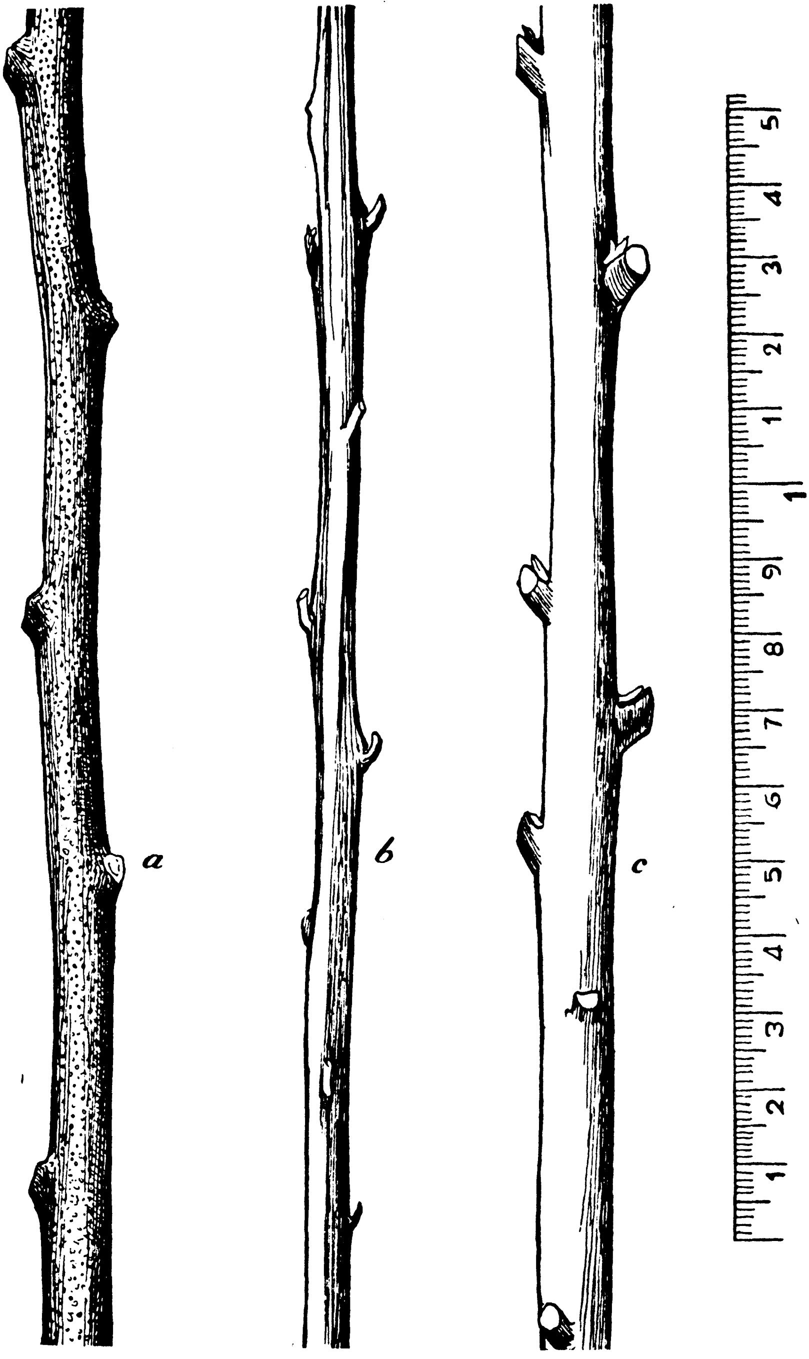


FIG. 28. **Illustrating petioled and nonpetioled bud wood—(*a*) Cherimoya, nonpetioled bud wood; (*b*) orange, petioled; and (*c*) avocado, petioled**

that have heretofore escaped the horticulturist. In the temperate Zone, there is little or nothing to accomplish in this direction, but in the Tropics the field is yet to a great extent unexplored and offers a profitable reward to the careful and patient experimenter.

The following terms are in use relative to graftage: *Stock*, by which is understood the plant on which the operation is performed; *scion*, the part taken from the plant which it is desired to perpetuate and which is grafted upon the stock (in budding the scion is usually referred to as budwood); *bud*, that part of the scion transferred to the stock in the act of budding.

The theory underlying graftage is one of the most fundamental principles upon which rests modern horticulture, and more particularly fruit growing.

Physiologically, affinity between the two parts joined is the governing principle that affects the practice. Unless there is sufficient relationship between the two parts, stock and scion, there can be no union, and the true state of affinity between two species or varieties is indicated by the facility with which the union forms and by the degree of vigor, health and longevity exhibited by the grafted plant.

Always provided that the conditions under which the work can be successfully performed are known and observed, scions of a given species may be grafted or budded on another plant of the same species; for instance a scion of one orange tree may always be grafted on another orange tree. One species may also be budded on another in the same genus; for instance

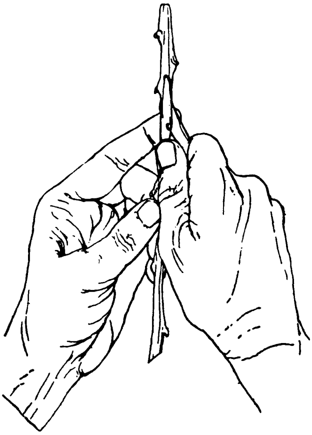


FIG. 29. Cutting a shield bud

the orange on the pomelo. In some instances the species in one genus may be budded on a species in another genus, to mention the biriba on the custardapple. Then again, one species may fail on another in the same genus; for instance, the cherimoya does not grow well on the soursop.

In very rare instances, such as the species in the genus *Coffea,* in order that the grafted plants may be of normal habit it is necessary that the scions be taken from *stems only,* for if scions are employed from the horizontal branches the resulting plant does not produce an upright stem, but assumes a dwarf, spreading or trailing habit (fig. 30.)

The season apparently exercise some influence in regard to the facility with which unions form in some species, for instance, the guava, and it may well be that this is true of many other plants. In this connection it should be stated that the experimental work upon which the greater part of the directions on pages 65–76 are mostly based was conducted beginning in the month of November and concluded by the end of May. This time of the year constituted the dry season.

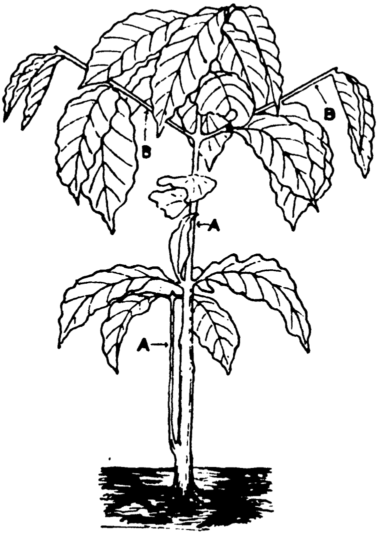


FIG. 30. Coffee plant, illustrating (A) the growths that should be used for scions in order to obtain normal growth on the budded plants; (B) inappropriate branches the use of which for scions produces dwarf, spreading trees

The following advantages are derived from grafting:

(1) The stock best adapted to the soil and climate, or most resistant to certain insect pests and diseases can be used;

thus a fruit grafted upon the proper stock can be cultivated in a region where cultivation on its own roots would be impossible.

(2) Any variety may be grown to any extent desired: (*a*) the uniformity and quality of the fruit is assured, and (*b*) the season of maturity is to a large extent controlled.

(3) Grafted trees are smaller and bear fruit earlier than seedlings, and therefore: (*a*) They yield a profit earlier, (*b*) the fruit is gathered with more facility, (*c*) they are less liable to injury from typhoons, (*d*) the eradication and control of plant pests are more easily effected in dwarf than in tall trees, and (*e*) by shadowing the ground the dwarf trees assist in conserving the moisture in the land during the dry season better than the tall ones. Many people are under the impression that graftage effects a transformation in the plant for the better, irrespective of the source of the scion. This is, of course, an absurd belief. A grafted plant produces fruit similar to that from which the scion was obtained, except where it may be influenced by the stock and a new environment. Graftage itself is not an improvement, but the means by which the improvement is effected. In order that the grafted plant may be an improvement upon the seedling, the scion must have been taken from a tree bearing superior fruit.

In the broad sense of the word, grafting does not change the character of the scion, for if it did, the process would be valueless. However, there are many well-authenticated records of the inter-influence between stock and scion. Careful horticulturists are beginning to recognize the influence of the stock upon the scion and it is safe to caution against the extensive planting of a certain variety of fruit budded upon a stock of unknown merit.

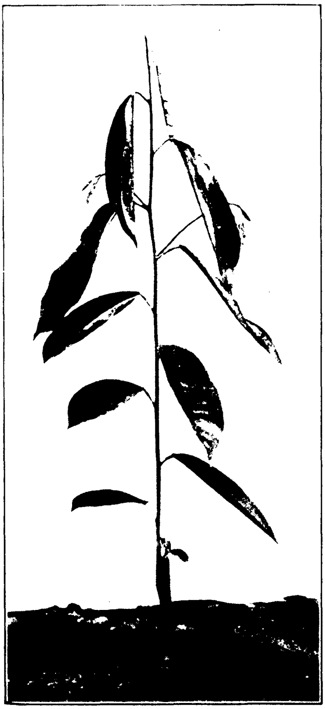
The different variations of graftage may be classified into (*a*) budding, (*b*) grafting, and (*c*) inarching, or grafting by approach.

BUDDING

Budding is the art of transferring a small section of bark bearing a bud from one plant to another. There are two distinct methods of budding: (*a*) Shield budding, illustrated in figs. 31-32, which consists of cutting a shield-shaped portion of the budstick and inserting it under the bark of the stock in an opening made for that purpose; and (*b*) patch budding, illustrated in fig. 33, which method consists of the removal of a section of bark from the stock, usually square or rectangular,

(*a*) Shield budded Carambola

(*b*) Shield budded Cacao



(*c*) Shield budded Durian

(*d*) Shield budded Tamarind

exposing the cambium layer, and replacing it with another section of bark from the scion with a dormant bud of the same size. Annular, or flute budding, is a modification of patch budding (fig. 34).

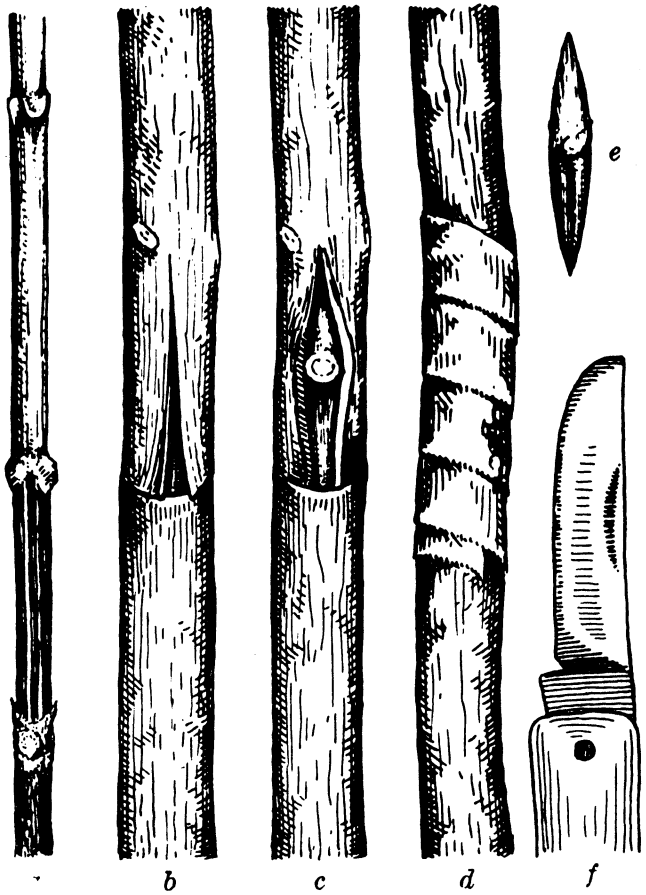


FIG. 31. Shield budding in progressive stages—(*a*) Budwood; (*b*) stock ready for insertion of bud; (*c*) bud inserted; (*d*) bud inserted and tied; (*e*) bud; (*f*) budding knife

SHIELD BUDDING

For propagating work in the nursery or the orchard, the simplicity of the method and the rapidity with which the work can be performed, coupled with great economy of material—a valuable feature where material is scarce—renders the method of shield budding preferable to all other methods of grafting on all species on which it can be successfully performed.

Many people are under the impression that shield budding is a difficult and complicated operation that requires special knowledge, and which is correspondingly difficult to learn and perform. As a matter of fact, *shield budding is the simplest method of grafting devised.* Some judgment must of course be exercised in all matters pertaining to the work, but the performing of actual work of budding itself is a mere matter of manual skill that anyone can master who is at all deft in the handling of a knife. However, the following essential points must be observed in order that the budding may be successful:

(1) The stock plants must be in such condition that the bark separates readily from the wood, allowing the easy introduction of the bud.

(2) A budding knife adapted to the purpose, keen edged and clean of all impurities. Note the remarks on page 19 and see fig. 32, *f*.

(3) Proper budwood. The selection of the budwood, with the exception of a few species, is perhaps the most difficult problem for the beginner. Immature budwood does not take, and the cutting of buds from old and hard material is difficult. Generally speaking, budwood from the second and third growths from the end of a twig, 6 to 8 millimeters in diameter, makes good budwood. In some plants, however, for instance those belonging to the *Annonaceae*,[1] the last season's growth from which the leaves have been shed is the most preferable. In species with both angled and round budwood, like the orange, the round wood is preferable. In thorny species, spineless budwood or budwood with small, weak spines, should be selected.

In the past, when shield budding was confined to a few species, the type of budwood employed in budding citrus fruits, in this publication referred to as "petioled budwood," seems to have been satisfactory for all other species also. But as the practice has been extended to several species of tropical fruits that hitherto have been grown from seed, it has been found that as species vary structurally, so there are also certain modifications in the art of budding, as generally practiced, which are necessary in order that the operation may be successful. One of these refers to the budwood. In most species the buds are sunk into the bark tissue, and if the growths are accidentally broken off, new ones come forth if proper attention is given to the budded plant. The avocado is an exception to this rule, in that the buds are mostly superficial upon the bark and frequently grow hard and are shed in the course of a few months. Here rather tender or partly mature budwood with well-developed buds should be selected or a large percentage of the buds will fail to grow after they have taken, for such "blind" buds, as they are called, are incapable of producing any growth whatever. Again, budding experiments conducted at the Lamao Experiment Station with many species of tropical fruits show that in shield budding these may be also divided into two groups: (1) those species, the budwood of which may be cut at the time of budding and the petioles cut off close to the bud, including among others the citrus fruits, the avocado, guava, carambola and catmon, for which the author has proposed the name "petioled budwood" in a recent publication [1] in contradistinction to (2) those species in which it has been found essential to cut off the leaves of the budwood while this is still attached to the plant, some time in advance, say two weeks from the date of budding, in order to induce the dropping of the leaves and the formation of a well-healed leaf-scar, such as the cacao, mango, hevi and santol; scions so treated are referred to as "nonpetioled budwood." For an illustration of petioled and nonpetioled budwood see Plate III and fig. 28.

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[1] For instance, the soursop, sugarapple, and custardapple.

(4) The budwood should not be allowed to dry out from exposure to the air and sun. It is well to keep the budwood protected from the dry atmosphere in a small tin box or covered with moist cloth or paper as the budding proceeds.

(5) The similarity or dissimilarity of the age and appearance of the scion and the stock at the point of insertion of the bud has apparently been considered of no importance in the species budded in the past, and while the experiments conducted at Lamao have shown that in most species this evidently is an unimportant consideration, in others the similarity of the age and appearance of the scion and the stock at the point of insertion is of prime importance, for instance in the mango, cacao and santol.

(6) The bud should be cut so that there is no break or tear in the tissues.

(7) The bud should be inserted immediately after it is cut and should be tied at once.

(8) No water or impurities should be permitted to enter the bud.

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[1] *Philippine Agricultural Review*, Vol. VIII, No. 1, 1915, p. 59.

In attempting to bud a species regarding which the detailed requirements are not known, it is best to use nonpetioled budwood of the same age and appearance as the stock at the point of insertion of the bud.

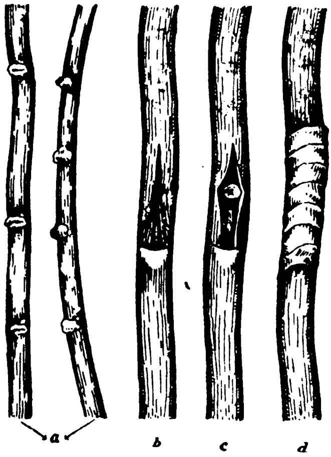

FIG. 32. Shield budding cacao—(*a*) Scions; (*b*) stock ready for insertion of bud; (*c*) bud inserted; (*d*) bud tied. (Much reduced.)

When the stocks have attained a diameter of 1 centimeter or more, they are ready for budding. Provided that the stocks are in good condition for budding, this work may be performed any time of the year. However, in those regions that have a pronounced wet and dry season, budding is inadvisable during the rainy season, partly because the water is so apt to enter and destroy the bud, and partly on account of the mud that sticks to everything with which it comes in contact and thus hampers the work. Under these circumstances the budding should be performed during the dry season. Where the rainfall is evenly distributed throughout the year, advantage should be taken of the bright and sunshiny days that are usually frequent the year round.

Before the actual budding is begun, the nursery should be weeded and all twigs and spines trimmed off the stock from the base to about 20 centimeters above the ground. (Plate II.)

The budding operations should be performed in the following order: With the point of the knife make a vertical cut 3 to 4 centimeters long through the bark to the cambium layer in the stock, and at the lower end of the cut make a horizontal cut so that the wound appears like an inverted T (fig. 31, *b*). Then

(*a*) Shield budded Katmon

(*b*) Shield budded Barobo

(*c*) Shield budded Icaco

(*d*) Side grafted Lanzon

in order to facilitate the insertion of the bud, lift the bark by passing the point of the blade upward under the bark along the vertical incision, loosening the bark so that the bud easily slips into place. In some species, the bark of which is very thick, for instance the cacao, the annonaceous plants and even the mango, it is well to make a sloping cut in the bark below the horizontal cut in order to facilitate the insertion of the bud without injury. Next cut a bud by passing the knife diagonally under the bud (fig. 29), taking care not to cut the bud too thin and that no break or tear is made in the tissues. This is liable to occur if the knife is held at too obtuse an angle to the budstick. Ordinarily a bud should not be cut less than 2 nor more than 4 centimeters long. In thick-barked and rapidly growing species, the buds should be cut large with an ample woodshield, as otherwise they are in danger of being grown over by the callus after they have taken and before the budgrowth has started. Insert the bud (fig. 31, *c*), and tie firmly with grafting tape, without strangling,[1] beginning at the point of insertion and covering the whole bud so that no water can enter[2] (fig. 31, *d*).

The bud should be inserted as near the ground as is practicable (fig. 39), for this will save much time later in rubbing off adventitious sprouts; also, the buds have a tendency to sprout more readily when they are placed near the ground than when they are inserted higher up on the stock.

The budder should hold the budstick with the top end towards him in the act of cutting the bud, for the wood is then less likely to split than if it is held in a reverse position (fig. 29).

The greatest care should be exercised in cutting budwood from those trees that it is desired to propagate, and in seeing to correct labeling. In cutting petioled budwood, all leaves should be trimmed off and the budwood wrapped in damp cloth; carefully avoid all bruising.

The above method is the most recent and advanced modification of shield budding and is gaining steadily in popularity. The original method consisted in making the perpendicular cut below the point of intersection instead of above, and the buds were pushed downward.

Ten to fourteen days after the insertion of the buds they should be examined; if a good callus has formed around the bud shield, unwrap the tape to below the leaf-bud proper (fig. 31, *e*) and lop the stock 6 to 8 centimeters above the bud (fig. 39). Lopping is done by making a cut about two thirds through the stock with a pruning saw or knife and then bending the top over, taking care that the stock does not split downward. The plants should be lopped so that each alternate space between the rows is free for cultivation (fig. 40).

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[1] That is, not too tight.

[2] In the case of species that require less care in handling than the average, the orange, for instance, complete covering of the bud is not important provided no rain or other water enters the bud incision before union has taken place.

In vigorous and rapidly growing species, it is especially important that the unwrapping and lopping be attended to as soon as a good union has formed, for otherwise the callus soon covers and smothers the bud. For the same reason, the plants should be attended to after the lopping, and all sprouts on the stock rubbed off every week or ten days.

In some species, for instance those belonging to the genus *Mangifera,* it is necessary to cut off the stock 20 to 25 cm. above the bud after it has taken in order to force it into growth. Ordinary lopping does not accomplish the purpose.

When the buds have made a growth of about 30 to 50 centimeters, the stock should be cut off smoothly, just above the union, with a sharp knife. Ordinarily this is not necessary, but in the case of soft-wooded plants which are easily infested by fungi, such as the avocado, the cacao, the cherimoya, etc., it is advisable to paint the wound with white lead, linseed oil or coal tar. At the same time, such plants as have a tendency to fall over instead of growing upright should be staked and tied. Split bamboo canes, 1 to 1.25 meters long, furnish cheap and excellent stakes. When the plants have attained the height of one meter or more, they are ready for the orchard.

There is also a variation of shield budding where the section of bark is removed, equivalent to the shield bud, and the bud put in place and tied, instead of being inserted under the bark as already described. This method has an advantage in that the stock can be budded whether the sap is flowing or not. It is not recommended for general use, however, and has so far not gained any popularity.

PATCH BUDDING

Patch budding is far more cumbersome than shield budding, and should never be used where shield budding can be successfully employed. However, patch budding may sometimes be used to advantage. In patch budding, the stock should be of greater diameter than in shield budding, and the work can not be performed unless the sap is flowing freely in both the stock and scion, and the bark and wood separate readily. Patch budding is illustrated in fig. 33, and its more practical modification, annular budding, in fig. 34. These figures show the method of operation better than any written description. Several tools have been devised for cutting patch buds of exactly the same size and dimensions as the removed bark in the stock, none of which have been quite satisfactory.

FIG. 33. Patch budding—(*a*) Stock, with a section of the bark removed for the reception of the bud; (*b*) stock after the bud has been placed in position and tied; (*c*) bud wood with a patch bud removed; (*d*) patch bud ready to be placed on stock

ANNULAR BUDDING

For annular budding an implement has been invented consisting of two sharp blades, rigidly fixed parallel to each other. These are passed around the stock, cutting the bark to the cambium layer. The bark between the two cuts is then removed and the same operation performed upon the budwood; the bark ring of the scion is then split longitudinally with a knife and placed on the stock (fig. 34). The bud is then carefully tied and subsequently treated according to the directions already given under shield budding.

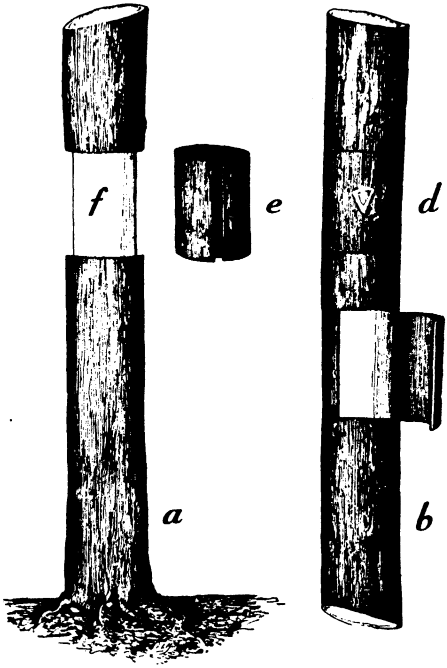

FIG. 34. Annular budding—(*a*) Section of stock with the bark removed for the reception of the bud; (*b*) bud wood; (*c*) a bud seen from the back, partly loosened from the bud wood; (*d*) the front part of a bud after the horizontal cuts have been made; (*e*) the bud loosened from the bud wood, ready to be placed around the stock at (*f*)

GRAFTING

The methods of grafting are numerous and it would be a waste of time and space to discuss any but a few of the simplest and most practical. Some modes of grafting, for instance the different kinds of saddle graft, would seem to have been invented with the view of consuming the maximum amount of time in the operation and of making it as complicated and difficult as possible.

Even the simplest methods of grafting are vastly more cumbersome and wasteful of time and material than shield budding, and should, therefore, never be employed where shield budding is practical. Cleft, crown and side grafting are the only methods that may be considered practicable in the Tropics by a modern horticulturist. The principal use of grafting is in working over old trees though young stock may also be grafted to advantage.

(*a*) Shield budded Litchi

(*b*) Shield budded Alpay

(*c*) Shield budded Vilatti

(*d*) Shield budded Mabolo

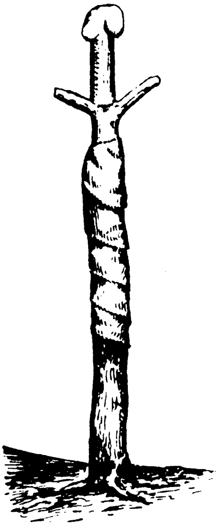

FIG. 35. Cleft grafted coffee, tied and waxed

CLEFT GRAFTING

Cut off the stock at right angles at the point where it is desired to insert the scion. Then split the stump with a knife or a grafting tool and mallet; prepare a wedge-shaped scion 75 to 125 millimeters long, carrying three or four buds, and insert

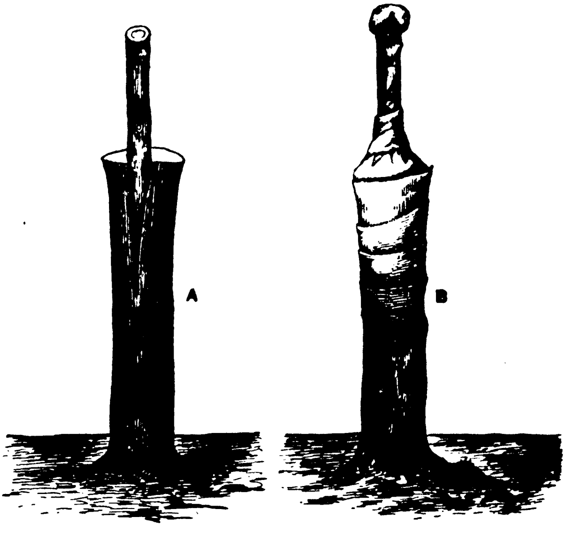

FIG. 36. Cleft grafling—(A) Scion inserted: (B) scion inserted, tied and waxed

it in the cleft, in the meantime holding the cleft open with a wedge or the end of the grafting tool. Two scions may be inserted in the same cleft, one at each edge. It is important that the cambium layers[1] of the stock and scion be placed in close contact. Tie with soft cotton twine or grafting tape, and cover the wounds well with grafting wax to prevent the escape of moisture, and to protect them from rain and dew and the entrance of fungi (figs. 35 and 36). If the graft is made near the ground, it is advisable to cover both stock and part of the scion with soil.

CROWN GRAFTING

This differs but little from cleft grafting. Cut off the stock near the ground as described above. Then insert the point of the knife in a concave place between the bark and the wood, and loosen the bark. If the stump is convex all around, make a perpendicular slit in the bark and lift the edges as in shield budding. Now prepare the scion by making a sloping cut about 4 centimeters long as illustrated for side grafting in fig. 38, c, and insert it with the cut surface towards the wood. Tie and wax as already described for the cleft graft. As in the cleft graft, one or several crown grafts may be inserted in the same stock simultaneously (fig. 37).

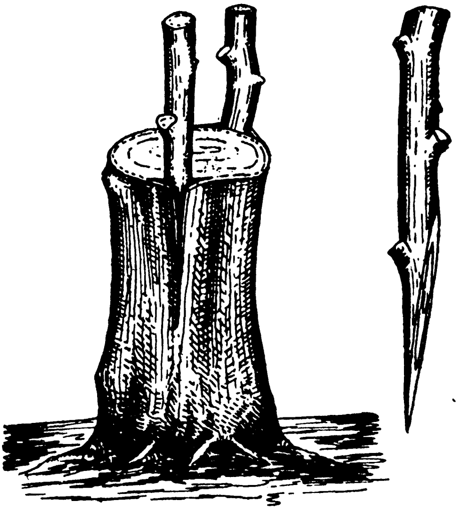

FIG. 37. Crown grafting: Showing scion prepared ready for insertion and two scions inserted in stock

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[1] The line of demarkation between the wood and the bark.

SIDE GRAFTING

There are several variations of the side graft, only two of which are worthy of attention. One consists of making a slanting cut downward in the stock near the ground; a wedgeshaped scion is then prepared and inserted in the cut (fig. 38, *a* and *d*). According to the other method, a vertical and cross cut is made in the bark as preparatory to the insertion to a T shield bud, then a scion is prepared as for the crown graft and inserted (fig. 38, *b* and *c*). Carefully tie and wax all cut surfaces on both stock and scion in order to protect them from the sun.

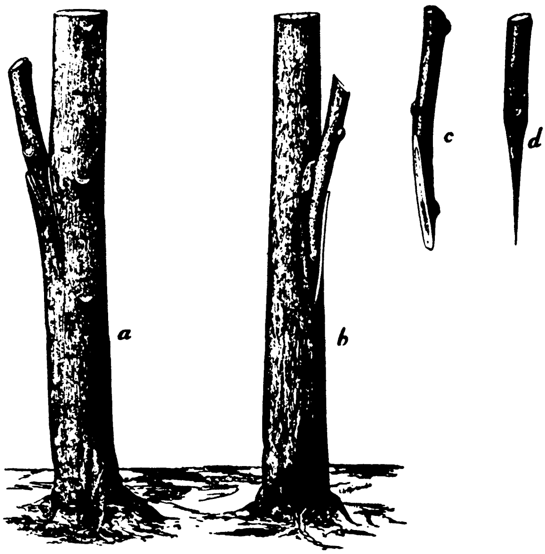

FIG. 38. Two methods of side grafting—(*a*) Section of stock with scion inserted before being tied; (*b*) section of stock with scion inserted before being tied; (*c*) scion prepared for method shown in (*b*); (*d*) scion prepared for method shown in (*a*)

When the graft has taken, lop the stock and treat the plant as directed under shield budding. Side grafting should be used preferably on comparatively young plants only.

In side grafting, the top should be gradually removed as soon as the graft is well callused.

HERBACEOUS GRAFTING

Herbaceous grafting is a method sometimes employed in plant propagation of herbaceous or fleshy plants, such as the papaya, flowering perennial plants or *Cactae*. In contrast to all other forms of graftage, a successful union here is not dependent upon the contact of the cambiums of stock and scion, as the entire cut surface of the two parts joined consists of living cells. Most of the foliage should be removed from the scion, (see fig. 42) which may be inserted in the stock as a cleft or side graft and is then tied as already described for the cleft graft.

In cleft or side grafting papayas (Plate IV, *b* and *c*, and fig. 42), the grafting tape should be partly removed as soon as the union has formed, or fungi rapidly enter and destroy both stock and scion.

INARCHING

Inarching is the most primitive and complicated method of graftage, yet even this has its uses under certain circumstances (fig. 43). However, it is growing more obsolete as other methods of graftage are becoming better known. For the purpose of inarching, the plants should be reared in boxes, bamboo tubes, or pots (see page 32). The plants are ready for inarching when they are about the size of a lead pencil. Preparatory to inarching, a stout scaffold should be erected around the tree which is to furnish the scions, and particular care should be taken to see that the scaffold is well braced in order to prevent its swaying in the wind. As a further precaution, the inarched branches should be firmly tied to the scaffolding.

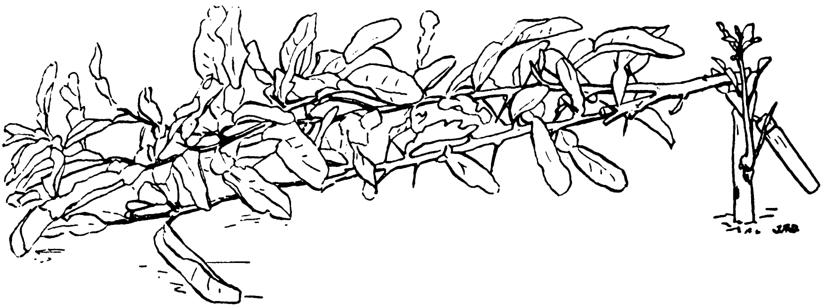

Fig. 39. Lopped plant showing a sprouting bud

The work is performed by removing the bark of the seedling with one cut of a sharp knife so as to expose the cambium layer for about 7 centimeters as near the roots of the stock as possible; and performing the same operation about 7.5 to 10 centimeters from the terminal bud of the branch which is to be inarched, selecting a twig that is as nearly of the same diameter as the stock as possible, so that when the two cut surfaces are brought together they will make a snug fit. Then tie with waxed cotton twine or tape. Whether the cut surface is covered entirely

(*a*) Longan shield budded on Alpay

(*b*) Paniala shield budded

(*c*) Shield budded Guisaro

(*d*) Shield budded Dalinsi

with the tying material or not is immaterial. Fasten the stock plant firmly to the staging in order to prevent dislocation of the stock and scion by wind movement. Unless the stocks are well shaded by the tree, the receptacles should be shaded from the sun by burlapping or sacking tied over them. Simple as this expedient may seem, it is quite important in the production of strong and healthy plants. Watering of the stocks should be regularly attended to, for if this is neglected it also results in retarding the formation of the union and producing weak plants.

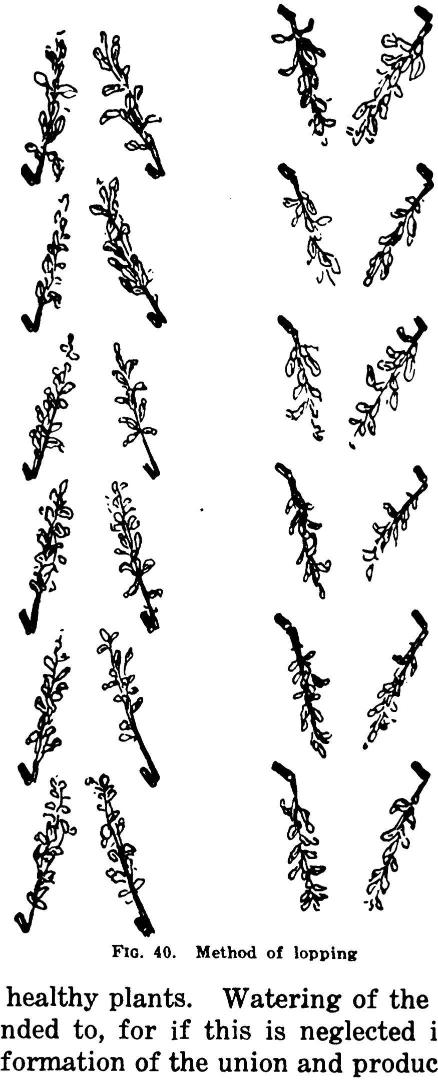

FIG. 40. Method of lopping

About two or three weeks after the inarch is made, cut a notch in the scion just below the union, and another in the stock just above; after a week the lower notch should be made a little deeper and the top of the stock cut away. Six weeks after the inarch is made the plant can usually be severed from the tree. If both stock and scion are in vigorous, growing condition and are well attended to, the union will form in a much shorter time.

If for any reason, the union takes place very slowly, the scion may make more top than the stock is able to support, and in this case part of the top should be trimmed off when the scion is severed from the parent tree, and the plant put in a shaded place until it has recuperated. The cut surfaces should be smoothed with a sharp knife and painted with white lead. Thereafter, the plants should be kept in the plant shed and be carefully attended to for a few months until they have become fairly well healed and have made a strong top, and then they may be set out in the field (fig. 46).

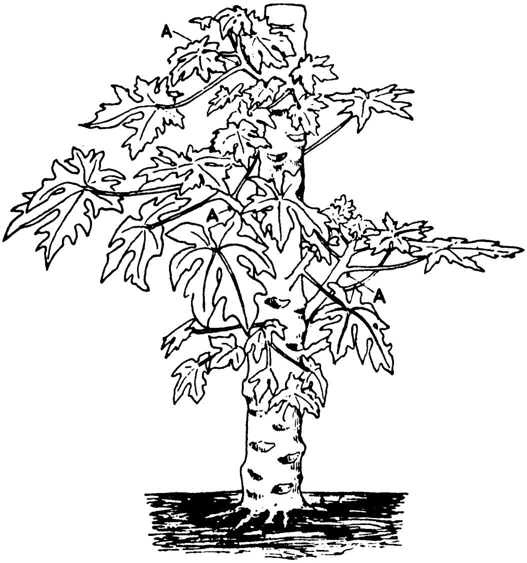

FIG. 41. Old papaya stump illustrating sprouts suitable for scions

LONG DISTANCE SHIPMENTS OF SCIONS

As a rule plant introduction is accomplished by the shipment of plants or seeds from one country into another. However, if stocks are available at the receiving point for the immediate insertion of the scions after their arrival it is frequently much cheaper and more convenient to import scions than plants, which, if the proper material is cut and judiciously packed, will keep in good condition for at least six weeks to two months.

Scions or cuttings for long-distance shipments should be cut

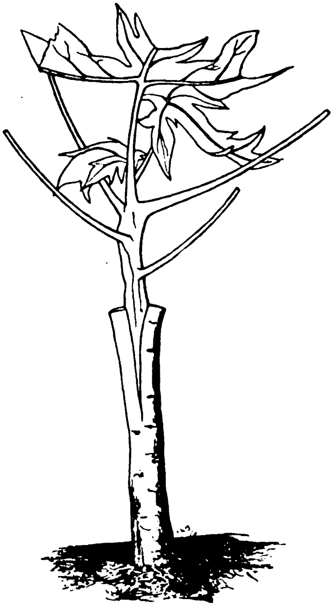

FIG. 42. Cleft grafting of the papaya, showing scion inserted before tying

as directed for the different species on pages 65–76, rather a trifle more mature than when the budwood is intended for immediate use, and after the dry period is so advanced that the season's growth is well hardened. Nonpetioled scions usually remain in good condition longer than petioled ones.

After being brought from the field to the packing house, the scions should be carefully examined, all injured or bruised scions should be discarded and the ends of the rest trimmed smooth with a sharp knife, and at the same time prevailing thorns on citrus and similar scions should be cut off. Then, each scion should be wrapped separately in moist, not wet, thin and soft manila paper or newspaper—just enough so that the scions do not touch each other, tied in bundles and placed in tin tubes or boxes, care being taken to fill empty space with paper or moss to that the scions shall be held firmly in position and are not loose in the tin, as if loose they are apt to injure each other in transit.

The scions, after being wrapped in the paper, may also be wrapped with a little moist sphagnum moss in oiled or waxed paper, and an outer cover of strong manila paper ready for mailing.

In packing scions for long-distance shipments the packing material should be moistened just enough to prevent its absorption of moisture from the scions. On the other hand so much moisture that the paper and moss feel wet should never be added, as this frequently causes the material to decay en route.

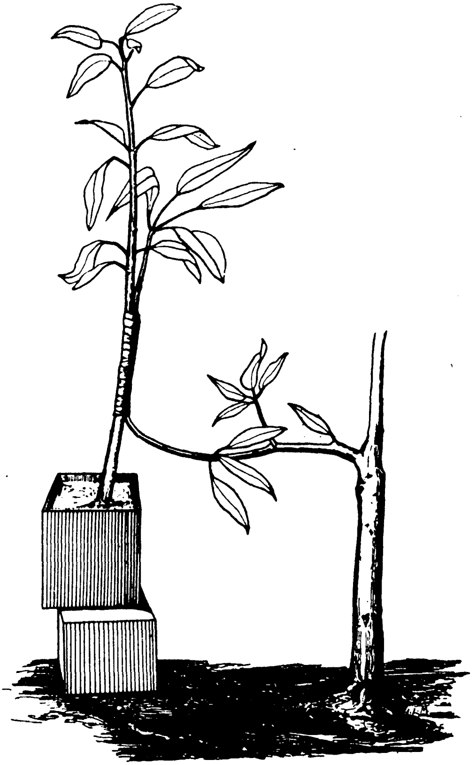

FIG. 43. Section of plant illustrating inarching

Scions that have been long in transit, and upon arrival appear dry and lifeless, may be revived by being wrapped in saturated sphagnum moss or cloth for 6 to 10 hours, if they are not too far gone.

BRIEF DIRECTIONS FOR THE VEGETATIVE PROPAGATION OF TROPICAL AND SEMI-TROPICAL FRUITS AND OTHER PLANTS

Most exogenous[1] plants are more or less readily propagated by marcottage during the rainy season, and all are easily propagated by inarching, though of course neither of these two methods can be considered anything but makeshifts until better methods shall have been devised, and are impracticable in the

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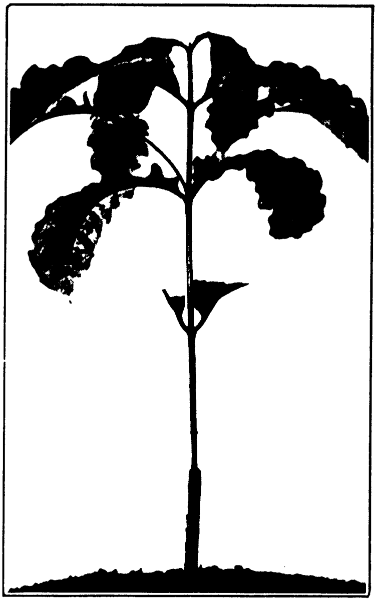
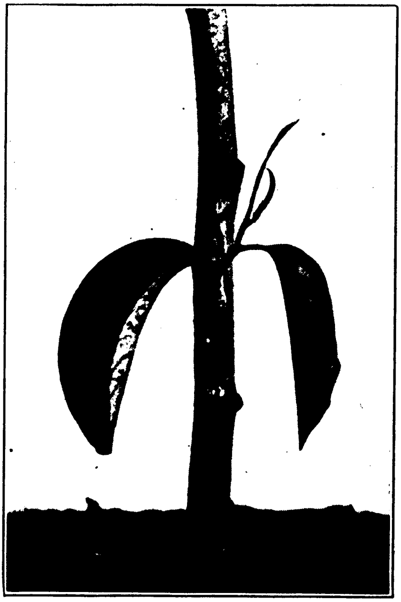
[1] Plants that grow or increase by external additions—outside growers, as opposed to endogenous plants, which grow from the inside.

(*a*) Shield budded and lopped coffee



(*b*) Shield budded Robusta coffee

(*c*) Shield budded Pili



(*d*) Shield budded Caimito

propagation of large numbers of plants. Layering may be resorted to in the case of a few bush fruits and grapes. Few fruits are successfully propagated from cuttings.

In all probability most species can be grafted if the right conditions obtain. Scions should then be selected of well-matured growths and the work carefully performed according to the directions given on pages 52–53.

It has been contended by some that a tropical climate is to a certain extent inimical to the budding and grafting of certain plants. In the experience of the author there are no grounds for such a contention, the work with the same species in Florida and in the Philippines showing no difference.

All directions hereinafter given are based upon observations or experiments made by the author or under his supervision, except where so indicated, and the experimental work has been conducted under the same conditions that would obtain in a nursery operated on commercial lines. Except where stated otherwise, it is understood that all species are propagated by inverted shield budding, and that the budwood as here described is used in this method of propagation. For descriptions of the terms "petioled" and "nonpetioled" budwood see pages 50–51. (Plate III, and fig. 28.)

The notes relative to each species mentioned should be read in conjunction with the general directions pertaining to shield budding or grafting.

The fact that one species in a genus can be budded, in all probability indicates that others in the same genus can also be budded by following the directions for its congener as closely as possible though this statement does not hold true in all instances. The experimental work in budding, etc., relative to many species is of such recent date that all conditions under which success is possible have not yet been determined, and in many species greater latitude, in the selection of scions, for instance, may doubtless be allowed than the directions hereinafter indicate. These directions indicate the conditions under which propagation has been successful. In all species where petioled budwood is used, nonpetioled budwood will, of course, serve the purpose equally well.

Abacá. *Musa textilis.* See Banana (fig. 12.)

Akee. *Blighia sapida.* Use nonpetioled, metallic blue-gray, mature budwood; cut the bud 4.5 to 5 centimeters long; age of stock at point of insertion of bud unimportant.

Alakáo. *Palaquium philippense.* Use nonpetioled, metallic-blue, mature budwood; cut the bud 4.5 to 5 centimeters long; age of stock at point of insertion of bud unimportant.

Alpay. *Euphoria cinerea.* Use nonpetioled, light-brown to greenish becoming rough, mature budwood; cut the bud 4 centimeters long; age of stock at point of insertion of bud unimportant. "Takes" on longan but growth is indifferent. (Plate X, *b.*)

Anigli. *Annona senegalensis.* Use nonpetioled, well-matured budwood from which the green color has disappeared; cut the buds 4 to 5 centimeters long; age of stock at point of insertion of bud unimportant.

Annatto. *Bixa orellana.* Use mature, greenish brown, petioled budwood; cut the buds 4 to 4.5 centimeters long; age of the stock at the point of insertion of the bud unimportant.

Atemoya. (Hybrid cherimoya x sugarapple.) See Cherimoya. Congenial stocks are: Sugarapple, cherimoya, custardapple, and some forms of the mamon.

Atíbu. *Rubus pectinellus.* Propagated by plantlets forming and rooting on the trailing vines.

Avocado. *Persea americana.* Use tender to mature, but green, smooth, petioled budwood; cut the buds 3.5 to 4.5 centimeters long; age of stock at point of insertion of bud unimportant. (Plate VI, *a.*)

Bael. *Belou marmelos.* Use petioled, green or purplish, fairly mature, not old and hard, thornless budwood; cut the buds 3.5 to 4 centimeters long; age of stock at point of insertion of bud unimportant.

Bamboo. *Bambusa spp.* Propagated by well-matured cuttings 25 to 40 centimeters long; 1.5 to 5 centimeters in diameter; with two nodes, the cut at the base immediately below the node; insert in the rainy season in sandy soil in a leaning position so that the upper node is level with the surface. (Plate V, *c* and fig. 24.)

Banágo. *Gnetum gnemon.* Has been shield budded at the Lamao experiment station.

Banana. *Musa sapientum,* etc. Readily propagated from the "suckers" that spring up from the rootstock of the old plants. (Fig. 12.)

Banáuak. *Uvaria rufa.* Use well-matured, dark-brown, nonpetioled budwood from which the tomentum has disappeared; cut the bud 3.5 to 4.5 centimeters long; age of stock at point of insertion of bud unimportant.

Baróbo. *Diplodiscus paniculatus.* Use petioled, mature, brownish to grayish budwood; cut the buds 3 to 4 centimeters long; age of stock at point of insertion of bud unimportant. (Plate IX, *b*.)

Bignay. *Antidesma bunius*. Use petioled, green, smooth, but fairly well-matured budwood with brown-colored lenticels; cut the buds 3.5 to 4 centimeters long; age of stock at point of insertion of bud unimportant. (Plate VI, *d*.)

Biriba. *Rollinia orthopetala*. See Cherimoya. Congenial stocks are: Mamon, custardapple, and guanabano. (Plate VII, *d*.)

Breadfruit, seedless. *Artocarpus communis*. Propagated by root cuttings, 20 to 25 centimeters long, 1 to 6 centimeters in diameter. See pages 38–39 and Plate V, *b*, and fig. 23.

Cacao. *Theobroma cacao*. Use nonpetioled, matured, brownish or grayish budwood that has been of slow formation, of current or last year's growth; cut the buds 4 to 5 centimeters long; insert in stock at the point of approximately the same age and appearance as the scion. (Plate VIII, *b* and fig. 32.)

Caimito. *Chrysophyllum cainito*. Use fairly mature, brownish to grayish, nonpetioled budwood; cut the buds 3.5 to 4 centimeters long; insert the buds in the stock at a point approximately of the same appearance as the scion. (Plate XII, *d*.)

Carambola. *Averrhoa carambola*. Use petioled, fairly mature smooth, purplish, but not old and hard budwood; cut the buds 2.5 to 3 centimeters long; age of stock at point of insertion of the bud unimportant. (Plate VIII, *a*.)

Cardamon. *Amomum cardamomum*. Propagated by division of the plants.

Carludovica. *Carludovica palmata*. Propagated by division of the plants during the rainy period.

Carob. *Ceratonia siliqua*. Grafting said to be in common use in Spain and Italy. Can probably be readily shield budded; fairly mature, petioled budwood is suggested as suitable.

Cashew. *Anacardium occidentale*. Use nonpetioled, mature budwood which is turning grayish; cut the bud 4 to 4.5 centimeters long; insert the bud in stock at a point of approximately the same age and appearance as the scion.

Cassava. *Manihot dulcis*. Propagated from cuttings about 20 centimeters long, made from the mature stems.

Ceará rubber. *Manihot glaziovii*. In Hawaii reported to be successfully propagated from well-matured hardwood cuttings. (Probably not less than 3.5 centimeters in diameter and from 0.5 to 1 meter long, set out during the rainy period.)

Cefalus. *Sarcocephalus esculentus*. Make hardwood cuttings of well matured growths 25 to 30 centimeters long and insert from two-thirds to three-fourths their length in sandy soil during the dry season. Easily budded.

Cériman. *Monstera deliciosa.* Propagated by division of the stems; each part should have not less than three "eyes," or buds.

Cherimoya. *Annona cherimolia.* Use well-matured, nonpetioled budwood of the last season's growth from which the green color has disappeared; cut the buds 4 to 5 centimeters long; age of stock at point of insertion of bud unimportant. Congenial stocks are: Custardapple, mamon, sugarapple.

Chico. *Achras zapota.* Said to be budded or grafted in India and British West Indies; details of method not known.

Cinchona. *Cinchona* spp. In Java sidegrafted as shown in fig. 38 *a.* The scion is made from fairly mature growths, 7.5 centimeters long, and inserted in stocks a little larger in diameter than a lead pencil, about 10 centimeters above the ground. All wounds are sealed by the use of melted wax. *C. succirubra* is considered as one of the best stocks.

Ciruela. *Spondias purpurea.* Readily propagated by cuttings, 50 to 75 centimeters long, from last year's growth or older, inserted into the ground about 30 centimeters in permanent position during the rainy reason.

Citron. *Citrus medica.* See Orange. Congenial stocks are: Orange, sour orange, pomelo, lime, rough lemon.

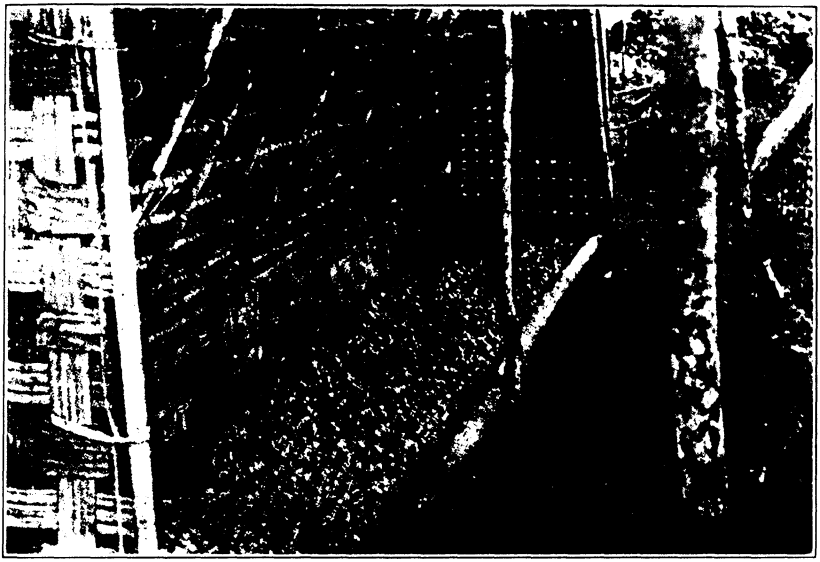
Coffee, Arabian, Liberian, Robusta, Excelsa, Quillou, Congo, etc. *Coffea* spp. Use well-matured, green to brownish or blackish, nonpetioled budwood; cut the buds 3.5 to 4 centimeters long; age and appearance of stock at the point of insertion unimportant. Readily cleft-grafted. Then, cut scions 5 to 7.5 centimeters long and insert in stock preferably not more than 2 centimeters in diameter, 10 centimeters above the ground. Seal all wound with grafting wax. *In order to produce normal trees the scions should be made from the stems, never from the branches.* Excelsa, Liberian, Abeocuta and related species are in Java considered to be the best stocks. (See also page 47, fig. 30 and 35, and Plate XII, *a* and *b.*)

Copela. *Rubus copelandi.* See Pilay.

Custardapple. *Annona reticulata.* See Cherimoya. Congenial stocks are: Guanabano, mamon, sugarapple.

Dalinsi. *Terminalia edulis.* Use petioled, with tomentum disappearing to smooth, fairly mature, brownish or grayish-green budwood; cut the buds 3.5 to 4 centimeters long; age of stock at point of insertion unimportant. (Plate XI, *d.*)

Date. *Phoenix dactylifera.* Propagated from the suckers growing at the base of the palm.



(*a*) Interior of germination shed for Cinchona

(*b*) Propagation of Tungulu by means of Layering

Dúhat. *Syzygium cumingi.* Use barely mature, green or reddish smooth, petioled budwood; cut the buds 4 to 4.5 centimeters long; age of stock at point of insertion of bud unimportant.

Durian. *Durio zibethinus.* Use nonpetioled, fairly mature, but not old and hard budwood; cut the bud 2.5 to 3.5 centimeters long; age of stock at point of insertion of bud unimportant. (Plate VIII, *c.*)

Feijoa. *Feijoa sellowiana.* Said to be propagated by layering in California and France. Has been shield budded at Lamao Experiment Station.

Ficus. *Ornamental trees and vines.* A very large number of species in this genus are easily propagated by hardwood cuttings even up to a diameter of 8 centimeters. All species are readily propagated by marcottage.

Fig. *Ficus carica.* Readily propagated by cuttings, 25 to 30 centimeters long, from well-ripened growths of last year's growth or older.

Genipa. *Genipa americana.* Use mature, bluish-green, smooth, non-petioled budwood; cut the buds 4 to 4.5 centimeters long; age of stock at point of insertion of the bud unimportant.

Ginger. *Zinziber officinale.* Propagated by division of the rootstock.

Granadilla. *Passiflora quadrangularis.* Propagated by cuttings, 25 to 30 centimeters long, from well-matured vines, inserted in sand or sandy soil.

Grape, Labrusca, Vinifera and Hybrids. *Vitis labrusca, V. vinifera.* Propagated by cuttings from well-ripened vines, 25 to 30 centimeters long, or by grafting.

Grape, muscadine, *Vitis rotundifolia.* Propagated by layering during the growing season, and by cuttings of well-ripened vines, 25 to 30 centimeters long, inserted in sandy soil during the dormant season, or by grafting.

Guanabano. *Annona muricata.* See Cherimoya. Congenial stocks are: Mamon, custardapple.

Guava. *Psidium guajava.* Use mature, barely brown-colored, petioled budwood; cut the buds 2.5 to 3 centimeters long; age of stock at point of insertion of the bud unimportant. Perform work from November to May.

Guisaro. *Psidium molle.* Use nonpetioled, mature, gray to brownish budwood; cut the bud 3 to 4 centimeters long; age of stock at point of insertion of bud unimportant (Plate XI, *c.*)

Hibiscus. *Hibiscus rosa sinensis.* Readily shield budded, cleft or side grafted, using fully mature, green to brownish and rough scions. Cleft grafting is preferable to other methods.

Hevi. *Spondias cytherea.* Use nonpetioled, slender, mature, but green and smooth budwood; cut large buds with ample wood-shield, 4 to 4.5 centimeters long; insert the buds in the stock at a point of approximately the same age and appearance as the scion. Stout hardwood cuttings may be rooted.

Hondapara. *Dillenia indica.* Use nonpetioled, slender, fairly mature, green to brown, hairy budwood; cut the buds 3.5 to 4.5 centimeters long; age of stock at point of insertion of bud unimportant.

Iba. *Phyllanthus acida.* Use nonpetioled, fairly mature, green to turning brown, smooth, slender budwood; cut large buds with ample woodshield 4 to 4.5 centimeters long; age of stock at point of insertion of the bud unimportant.

Icaco. *Chrysobalanus icaco.* Use petioled, fairly mature, greenish-brown budwood with lenticels well developed; cut the bud 3 to 3.5 centimeters long; age of stock at point of insertion of bud unimportant. (Plate IX, *c.*)

Huáni. *Mangifera odorata.* See Mango. Congenial stock: Mango. (Plate VII *b.*)

Jujube. *Ziziphus jujuba.* Use mature, grayish, tomentose, petioled budwood; cut the buds 3.5 to 4 centimeters long; age of stock at point of insertion unimportant.

Kabuyao. *Citrus hystrix.* See Orange. Congenial stocks are: Orange, pomelo and probably other related species.

Kaki. *Diospyros kaki.* Propagated by cleft and crown grafting. Shield budding is reported less satisfactory.

Kalamondin. *Citrus mitis.* See Orange. Congenial stocks are: Orange and pomelo, and probably other standard citrus stocks.

Kálpi. *Citrus webberi.* See Orange. Congenial stocks are: Orange, pomelo, kalamondin.

Kamanchíle. *Pithecolobium dulce.* Use barely matured, petioled budwood. Cut the buds from 2.5 to 3.5 centimeters long; the age of the stock at the point of insertion is unimportant.

Kami. *Cinnamomum mindanaense.* Use mature but green and smooth, petioled budwood; cut the buds 3.5 to 4 centimeters long; age of stock at the point of insertion of bud unimportant.

Kamia. *Averrhoa bilimbi.* Use nonpetioled, matured, brownish or grayish, still downy budwood; cut the buds 3.5 to 4.5 centimeters long; age of stock at point of insertion of bud unimportant. (Plate VI, *b.*)

Kansi. *Citrus hystrix* var. *boholensis.* See Orange. Congenial stocks are: Orange, pomelo, and probably other related species.

Katmón. *Dillenia philippinensis.* Use fairly mature, dark-green or purplish, smooth, petioled budwood; cut the buds 3 centimeters long; age of stock at point of insertion of bud unimportant. (Plate IX, *a.*)

Katúri. *Garcinia venulosa.* Use nonpetioled, green and smooth budwood; cut the bud 3.5 to 4 centimeters long; insert the bud at a point in the stock where the bark is green and smooth or at most streaked with gray.

Kayam. *Inocarpus edulis.* Has been shield budded at the Lamao experiment station.

Ketembilla. *Aberia gardneri.* Use petioled, preferably spineless, not too old budwood with tomentum still present; cut the buds 3 to 3.5 centimeters long; age of stock at point of insertion of buds unimportant.

Kinúbo. *Rubus moluccanus.* Readily propagated by layering.

Kubíli. *Cubilia blancoi.* Use nonpetioled, green and smooth to turning brown and rough, slender, fairly mature budwood; cut the buds 4 to 5.5 centimeters long; age of stock at point of insertion of bud unimportant.

Kudzu. *Pueraria thunbergiana.* Easily propagated by cuttings, each with two joints, from the mature vines.

Kumquat. *Fortunella japonica,* etc. See Orange. Congenial stocks are: Sour orange, orange and probably several other related species.

Lanzon. *Lansium domesticum.* Propagated by cleft or side grafting. The scion should be well matured but not of old growth, 6 to 8 centimeters long, 7 to 10 millimeters in diameter and inserted in the stock 6 to 10 centimeters above ground when at that height it is 7 to 15 millimeters in diameter; cover all wounds with grafting wax. Shield budding has been done but the percentage of successful buds has been small. (Plate IX, *d.*)

Lauriva. *Psidium laurifolium.* Has been shieldbudded at the Lamao experiment station.

Lemon. *Citrus limonia.* See Orange. Congenial stocks are: Sour orange, orange, rough lemon, pomelo, kalamondin, kalpi.

Lime. *Citrus aurantifolia.* See Orange. Congenial stocks are: Sour orange, orange, rough lemon, pomelo, kalamondin, kalpi.

Limon real. *Citrus excelsa.* See orange. Congenial stocks are: Orange, sour orange, pomelo, and probably other related species.

Lipoti. *Eugenia curranii.* Use nonpetioled, turning brown and rough, mature budwood; cut the bud 4 centimeters long; age of stock at point of insertion of bud unimportant.

Litchi. *Litchi chinensis.* Use nonpetioled, brown-gray, mature budwood; cut the bud 3.5 to 4 centimeters long; age of stock at point of insertion of bud unimportant. (Plate X, *a.*)

Loganberry. *Rubus* sp. Cover with soil the tips of the nearly full grown canes. Also propagated by division of the old plants.

Longan. *Euphoria longana.* Use nonpetioled, bluish-green to turning brown, mature budwood; cut the bud 4 to 4.5 centimeters long; age of stock at point of insertion of bud unimportant. Congenial stock: Alpay. (Plate XI, *a.*)

Loquat. *Eriobotrya japonica.* Use mature, greenish to brownish, slender, petioled budwood; cut the buds 4.5 centimeters long; age of stock at the point of insertion of the bud unimportant.

Mabolo. *Diospyros discolor.* Use petioled, fairly mature budwood with pubescence still adhering; cut the buds 4 centimeters long; insert buds in the stock at a point where it is green or becoming gray. Plate X, *d.*)

Maguey. *Agave cantala.* Propagated from the ratoons, suckers and bulbils (fig. 13).

Malpi. *Malpighia glabra.* Use petioled, light-gray to greenish, mature budwood; cut the buds 3.5 centimeters long; age of stock at point of insertion of bud unimportant.

Mamon. *Annona glabra.* See Cherimoya.

Mandarin. *Citrus nobilis.* See Orange. Congenial stocks are: Sour orange, orange, pomelo, rough lemon, lime, kalamondin, kalpi.

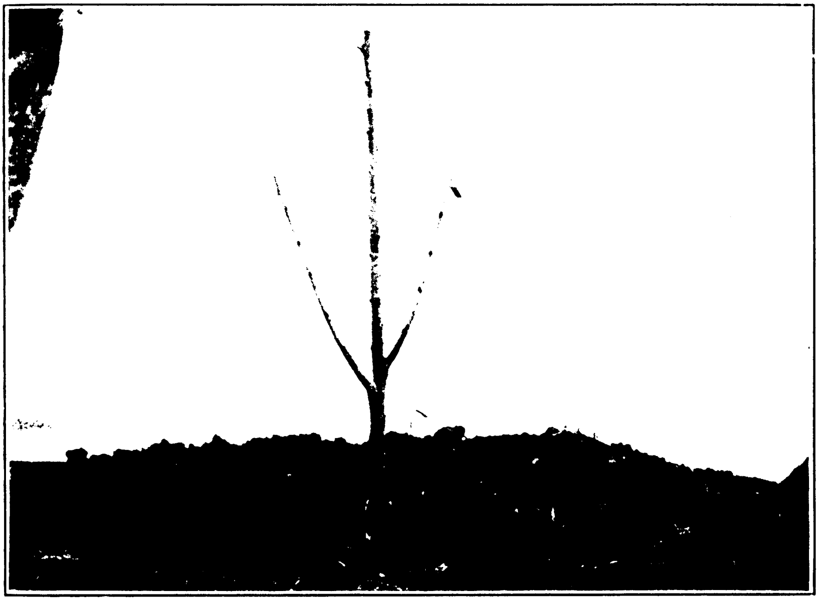
Mango. *Mangifera indica.* Use nonpetioled, mature, smooth, green budwood from the first, second or third flush; cut the buds 4 to 4.5 centimeters long with ample woodshield; insert the buds in stock at a point approximately of the same age and appearance as the scion. When union has formed cut off stock 20 to 25 centimeters above bud. Congenial stock: Huani.

Note.—Nonpetioled, rough and brownish scions can probably be used if inserted in the stock, at a point where the bark is of similar character. If this is feasible the stock could be budded at an earlier age and closer to the ground than if green scions were employed.

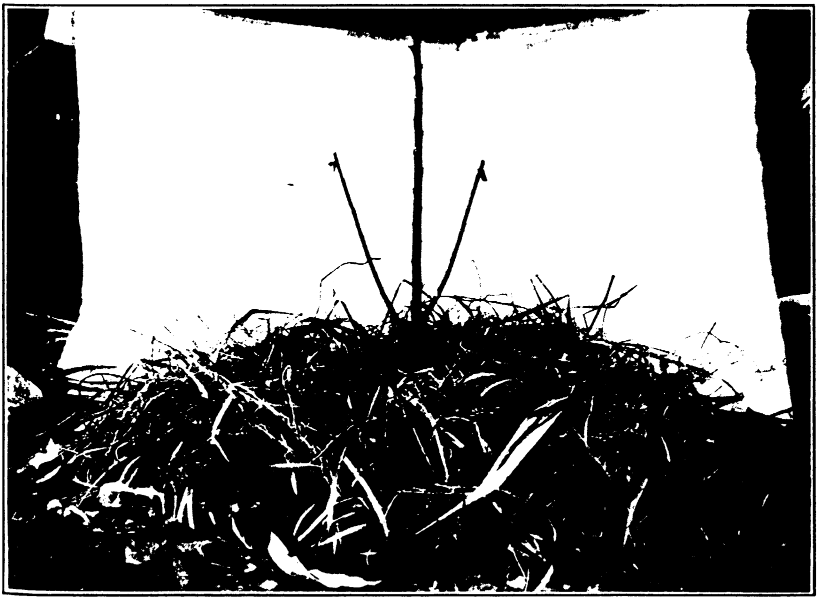
Mangosteen. *Garcinia mangostana.* Use mature, green and smooth, nonpetioled budwood; cut the buds 3.5 centimeters long; insert the buds in the stock at a point of the same appearance as the scion or at most where it is streaked with gray.

Marón. *Annona montana.* See Cherimoya.

Matasano. *Casimiroa edulis.* Use petioled, fairly mature,



(*a*) Shield-budded Soncoya on custardapple transplanted to the field showing basin for watering



(*b*) The same tree properly mulched in order to conserve the soil moisture

greenish budwood; cut the buds 3.5 centimeters long; age of stock at point of insertion of the bud unimportant.

Mombin. *Spondias lutea.* Use slender, smooth, glaucous, nonpetioled, mature budwood; cut the bud large, with ample woodshield, 4 to 5 centimeters long; insert the bud in the stock at a point of approximately the same age and appearance as the scion. Inclined to "bleed" badly.

Miáray. *Citrus miaray.* See Orange. Congenial stock: Kalamondin and probably other standard stocks.

Mulberry. *Morus nigra.* Propagated by cuttings from well-matured growths, 25 to 30 centimeters long, inserted in the soil. Readily shield budded; use well-ripened, petioled budwood; cut the buds 3 to 4 centimeters long; age of stock at point of insertion of bud unimportant.

Nelli. *Phyllanthus emblica.* Use mature, greenish-brown, petioled budwood; cut the buds 3.5 centimeters long; age of stock at point of insertion of the bud unimportant.

Orange. *Citrus sinensis.* Use fairly to well-matured, petioled, green and smooth, preferably spineless and round budwood; cut the buds 2.5 to 4 centimeters long; age of stock at point of insertion of bud unimportant. Congenial stocks are: Sour orange, rough lemon, pomelo, lime, kalamondin, kalpi.

Palanau. *Rubus fraxinifolius.* See Pilay.

Pangi. *Pangium edule.* Use slender, fairly mature, turning from bright green to bronze-green, nonpetioled budwood; cut the buds 4.5 to 5.5 centimeters long; age of stock at point of insertion of bud unimportant.

Paniala. *Flacourtia cataphracta.* Use petioled, matured, greenish-gray to brown budwood; cut the buds 3.5 centimeters long; age of stock at point of insertion of bud unimportant. (Plate XI, *b.*)

Papaya. *Carica papaya.* Propagated by cleft grafting and side grafting. Make grafts preferably not more than 10 centimeters above ground, in stocks preferably 20 to 30, not more than 50 centimeters high, or more than 2.5 centimeters in diameter at the point of union; in the cleft graft, if there is any considerable hollow in the stock, make the cleft to one side of it; in the side graft make the incision entirely outside of the hollow; make scions from sprouts about 7 centimeters long of old papayas; trim off nearly all leaf blades, leaving the petioles (figs. 41 and 42). Perform work late in afternoon and keep plants shaded. (See also page 60 and Plate IV, *b* and *c.*)

Parcha. *Passiflora laurifolia.* Readily propagated by cuttings from well-matured growths inserted in sandy soil, or by layering. Easily cleftgrafted and grows well on the Granadilla.

Pepper. *Piper nigrum.* Readily propagated from cuttings.

Pereskia. *Pereskia aculeata.* Propagated by cuttings 15 to 20 centimeters long, inserted preferably in sand or sandy soil during the dry season.

Phalsa. *Grewia asiatica.* Use mature, brownish, petioled, tomentose budwood; cut the buds 3.5 centimeters long; age of stock at point of insertion unimportant. (Plate VII, *a.*)

Piláy. *Rubus niveus.* The habit of this species indicates that it may be propagated by division of the old plants; probably also by hardwood cuttings inserted in sandy soil, or by covering the tips of the nearly full grown canes with soil.

Pili. *Canarium ovatum.* Use nonpetioled, slender, rather, smooth, brownish green budwood; cut the buds 4 to 5.5 centimeters long; insert the buds at a point in the stock of approximately the same appearance as the scion. (Plate XII, *c.*)

Pineapple. *Ananas sativus.* Propagated by slips, suckers, ratoons and crowns (fig. 15.)

Pitanga. *Eugenia uniflora.* Reported to be whip-grafted in South Florida, U. S. A.; can probably also be cleft- or side-grafted.

Pomegranate. *Punica granatum.* Readily propagated by cuttings made from well-ripened growths, 30 centimeters long, inserted in sandy soil.

Pomelo. *Citrus maxima.* See Orange. Congenial stocks are: Sour orange, orange, rough lemon, lime, kalamondin.

Ragini. *Rubus rosaefolius.* See Pilay.

Rambutan. *Nephelium lappaceum.* Use nonpetioled, brown-gray, mature budwood; cut the bud 4 to 4.5 centimeters long; age of stock at the point of insertion unimportant.

Ramie. *Boehmeria nivea.* Propagated by division of the roots.

Rima. *Artocarpus communis.* See Breadfruit.

Rolfeia. *Rubus rolfei.* Easily propagated by layering.

Roses. *Rosa* spp. Use petioled, green, mature budwood; cut the bud 2.5 to 3 centimeters long; age of stock at the point of insertion unimportant. Easily propagated from hardwood cuttings inserted in sandy soil.

Rubber, Para. *Hevea brasiliensis.* Recently reported to have been successfully budded in Java.

Sago palm. *Metroxylon sagu.* Propagated from the offshoots on the creeping stems.

Santol. *Sandoricum kœtjape.* Use nonpetioled, fairly mature turning brownish, grayish and rough, rather slender budwood;

cut the buds 3.5 to 4 centimeters long; insert buds in stock at point of same age and appearance as the scion. (Plate VI, *c.*)

Sisal. *Agave sisalana.* See Maguey.

Soncoya. *Annona purpurea.* See Cherimoya. Congenial stocks are: Custardapple and guanabano.

Sour orange. *Citrus aurantium.* See Orange. Congenial stocks are: Orange. jomelo, rough lemon and probably other related species.

Strawberry. *Fragraria chiloensis.* Propagated by division of the old plants and by the plantlets on the runners.

Sugarapple. *Annona squamosa.* See Cherimoya. Congenial stocks are: Custardapple and guanabano.

Sykamore. *Ficus sycomorus.* Readily propagated from cuttings made from growths a year or more old.

Tamarind. *Tamarindus indica.* Use petioled, well-matured, brownish or grayish budwod; cut the buds 3 centimeters long; age of stock at point of insertion of bud unimportant. (Plate VIII, *d.*)

Tamísan. *Citrus longispina.* See Orange. Congenial stocks are: Pomelo, and probably other standard citrus stocks.

Tangelo. (Hybrid mandarin X pomelo). See Orange. Congenial stocks are: Sour Orange, orange, pomelo, rough lemon, lime.

Tea. *Camellia thea.* In Java side grafted as shown in fig. 38 *a* and *d.*

Tersana. *Eugenia malaccensis.* Has been shield budded at the Lamao Experiment Station.

Tibao. *Rubus elmeri.* Readily propagated by layering.

Titao. *Rubus ellipticus.* See Pilay.

Tizon. *Citrus nobilis* var. *papillaris.* See Orange. Congenial stocks are: Orange, kalamondin, and probably other standard citrus stocks.

Tuna. *Opuntia tuna.* Propagated by breaking off and planting the joints during the dry season.

Túngulu. *Carissa grandiflora.* Readily propagated by layering, by merely covering branches with soil and keeping it moist. (Plate XIII, *b.*)

Uvero. *Coccoloba uvifera.* Use preferably nonpetioled, mature, but green and smooth to turning grayish, slender budwood; cut the buds 3.5 to 4 centimeters long; age of stock at point of insertion of buds unimportant. (Plate VII, *c.*)

Vanilla. *Vanilla* spp. Readily propagated from cuttings.

Vilatti. *Feronia limonia.* Use petioled, turning greenish or grayish, just mature, preferably spineless budwood; cut the buds

3 to 3.5 centimeters long; age of stock at point of insertion of bud unimportant. (Plate X, *c*.)

Wampi. *Claucena lansium.* Use barely mature, petioled budwood; cut the bud 4 to 5 centimeters long; age of stock at point of insertion of bud unimportant.

Yambo. *Caryophyllus jambos.* Use greenish to brownish and roughish, well-matured budwood; cut the buds 3 centimeters long; age of stock at point of insertion unimportant.

Yarúma. *Cecropia palmata.* A small percentage of cuttings will grow, made of well matured growths, not less than 3.5 centimeters in diameter.

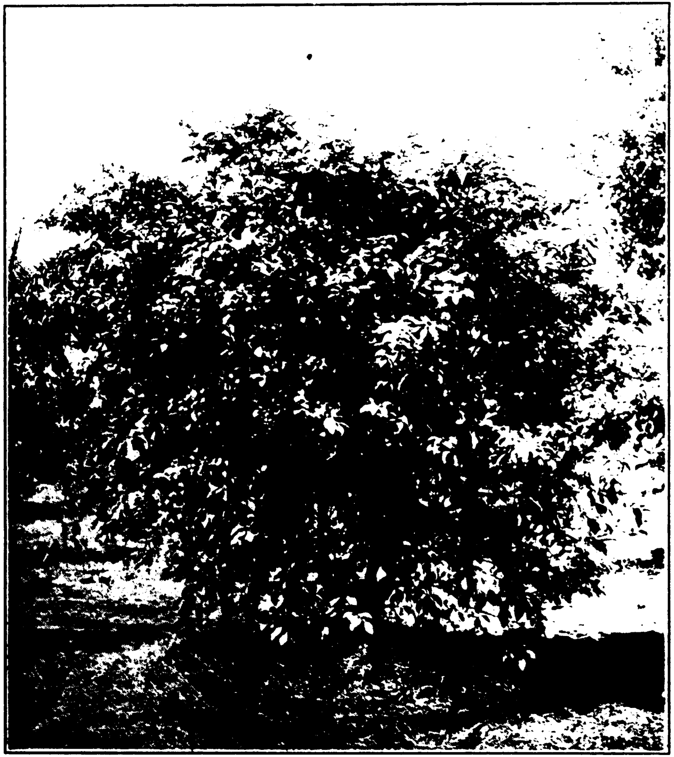
Zapote. *Diospyros ebenaster.* Use mature, but green and smooth petioled budwood; cut the buds 3.5 centimeters long; insert the bud at a point where the stock is green or brown before it becomes rough.

BRIEF DIRECTIONS FOR TREE PLANTING AND ORCHARD MANAGEMENT

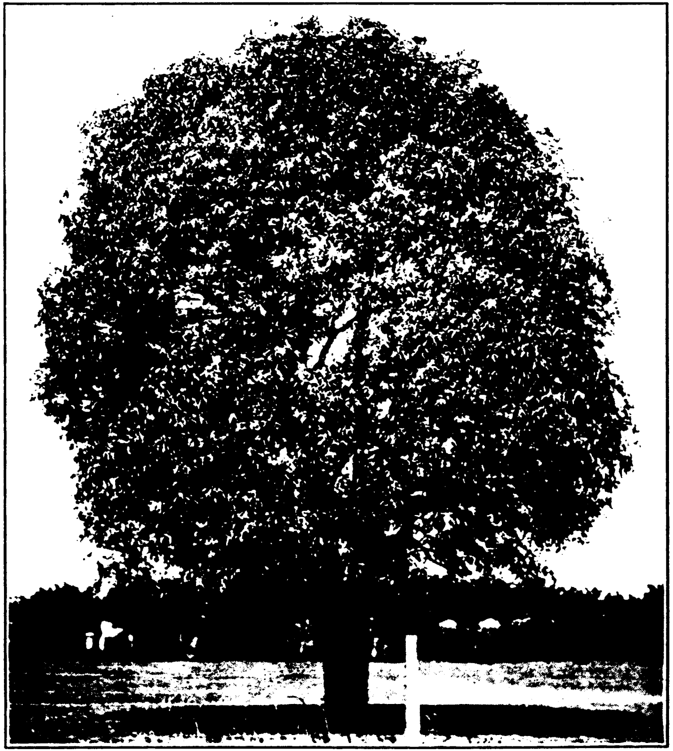
GENERAL REMARKS

There are very few rural homes in the Philippine Archipelago that are not surrounded by a more or less extensive collection of fruit trees and ornamental plants, and it is exceedingly deplorable that the system—if system it may be called—of close planting, with no cultivation, prevails everywhere. It is perhaps safe to say that the annual, miscellaneous fruit crop of the Philippines could be increased about one-third, probably more, without increasing the number of trees planted, if those already in existence were properly spaced and cultivated. Many years could be added to the life of these trees if the present practice of hacking the trees with bolos were discontinued, and intelligent pruning were adopted.

It is scarcely necessary to call attention to the fact that, where the trees are crowded, the most and the best fruit is always produced on the sides of the trees well exposed to the sun and air, excepting of course in those species where the fruit is carried on the stem and the large branches. Observation will show that, where the trees are too closely spaced, the result is poor yield and inferior fruit. Other things being equal, the production of large yields of fruit of superior flavor and quality is attainable only by spacing the trees sufficiently far apart to admit sun and air freely. Finally, it should be remembered that low-headed, dwarf trees, the convenient gathering of the fruit of which makes them preferable to tall trees and the spraying of which, when needed, is performed more easily, are incom-



(*a*) Kalpi shield budded on orange four year after planting in the field



(*b*) The Philippine Carabao mango. It is an excellent shade tree and produces a delicious fruit

patible with close spacing, for the reason that the absence of moving air, light and sun kills the lower branches and encourages a tall growth with a greatly reduced fruiting area. It is also conducive to the propagation and spread of fungi and noxious insects. Again, it is well to remember that seedling trees grow into larger trees than budded or grafted ones.

In order to better economize and utilize the area it is well to remember that certain plants like the lanzon, marang, kamia, cacao, and coffee succeed best interplanted with other plants which give them partial protection from the sun or wind.

In Java the Ipil-ipil, *Leucaena glauca,* is now most extensively employed interplanted with coffee for shade, the permanent shade trees being set out from 5 to 6 meters apart. In other countries Guamá, *Inga vera,* Silkoak, *Grevillea robusta* and various species of *Erythrina* and other trees are so employed. (See fig. 50 and Plate XIX.)

While it is true that many species of tropical fruits flourish on low and poorly drained land, nevertheless, excepting species that are indigenous to low and swampy places, the best-flavored fruit is produced in high and well-drained situations. Therefore, where a selection on the plantation is possible, the fruit orchard should be located where the soil is somewhat sandy, well drained and fairly deep, say not less than 40 centimeters. The above-mentioned points taken into consideration, the poorest land on the plantation will generally prove the best for a fruit orchard, for much of the land in the Philippines is so rich in nitrogen that the trees have a tendency to develop an excessively large top of luxuriant foliage at the expense of fruit production.

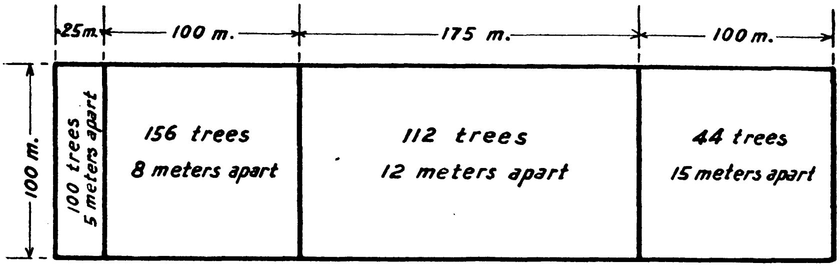
In looking for an investment, a prospective fruit grower, aside from the usual considerations relative to supply and demand, cost of land, irrigation facilities (where irrigation is necessary), cost of labor, transportation facilities, etc., should also consider the climatic requirements of the prospective crop or his attempt may end in disaster. For instance, to plant mangosteens, durians, pilis or lanzones in a region characterized by a long, dry season, to plant mangoes in wet districts, particularly where the rains coincide with the flowering season of mango, or to plant cherimoyas at low altitudes, would be courting failure. It is well to note that irrigation is not always a satisfactory substitute for atmospherical humidity, even though the majority of plants respond to it. In those regions marked by a long dry period, irrigation obtainable at a reasonable cost will always be found profitable, whatever crop is grown.

Citrus trees and avocados excepted, of which standard varieties have been imported by the Bureau of Agriculture, there are no established varieties of fruits in the Philippines asexually propagated. Under those circumstances, the grower should try to obtain seeds from a tree reputed to bear good fruits, be it a mango, lanzon, marang, chico or some other species, or better still, as the seedlings attain the requisite size, he should obtain budwood of the trees with the best all-around reputation for yield and quality of fruit in his district, wherewith to bud the plants.

When an orchard of any considerable area is planted to one species, the spacing of the trees is a matter easily disposed of, but where a collection of a few trees of many species is set out in one orchard the problem of spacing becomes more complicated because of the large number of species of tropical fruits and their wide range of size and habit. The employment of one distance in spacing the plants, unless these are chosen with reference to their size, inevitably results in the crowding of some species, while space is wasted in another part of the orchard.

This problem can best be solved by segregating the different species into four or five groups according to the spread of the tops. The distances 5, 8, 12, 15, and 18 meters will be found to be convenient space units and according to this plan in a variety orchard a species falls into one of these groups according to the size of the tree. The plan below shows the space allotted to each space unit and the number of trees required to occupy a variety orchard 4 hectares in extent using 4 space units.

Plan of 4 Hectare Variety Orchard



Scale $\frac{1}{250}$ m.

In the Planting Table on pages 128–29 the spacing for variety orchards in accordance with the above mentioned plan is given in a separate column.

STAKING AND PLANTING

During the season preceding the planting of the trees, all native vegetation should be cleared away and the land plowed and cross-plowed. If the land is poor it should be sown to a leguminous cover crop, such as cowpeas, Lyon beans, lima beans or mungos for plowing under before the land is staked.

Pains should be taken to plant the trees equidistant in straight rows, for this not only facilitates all subsequent work in the orchard and the planting of and caring for secondary crops, but also gives the orchard a more businesslike and attractive appearance.

The hexagonal or sextuple system of planting has an advantage over the square system in that by its use approximately 15 per cent more trees can be planted on a given area without additional crowding of the trees than by the use of the square system. The basis of the hexagonal system is the circle instead of the square, six trees being set out equidistant from a seventh placed in the center. The hexagonal is the only system that equally divides the space between the trees. In planting according to this system the staking is facilitated by marking the wire for the stakes alternately with two colors.

By the use of the quincunx system the number of trees per area is increased 78 per cent as compared with the square system but the trees are crowded accordingly and, contrary to a commonly accepted belief, this system therefore does not possess any advantage over the other systems of tree planting where thinning out of the trees is not contemplated.

TABLE SHOWING NUMBER OF TREES PER HECTARE PLANTED AT GIVEN DISTANCES ACCORDING TO THE SQUARE AND HEXAGONAL SYSTEMS.

Spacing	Square	Hexagonal
Meters	*Number of trees*	*Number of trees*
5×5	400	460
6×6	277	318
7×7	204	235
8×8	156	179
9×9	123	141
10×10	100	115
11×11	83	95
12×12	79	80

The difference of arrangement of the trees in the two abovementioned systems is illustrated in fig. 48.

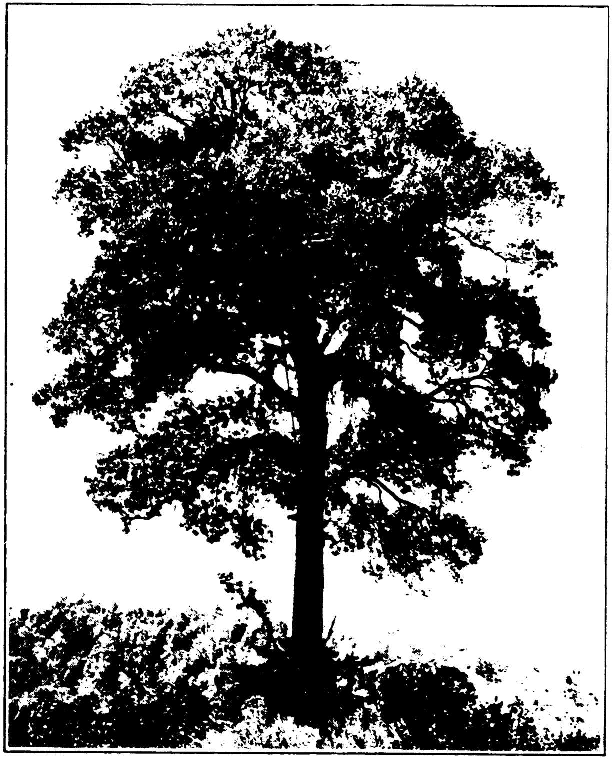
Before staking begins, take a wire sufficiently long to stretch across the field the shortest way, and mark off on the wire with bright colored paint the distance at which it is desired to plant the trees, and put aside until the paint has hardened.

The easiest way to square off and stake a field is to fasten a carpenter's square on the top of three stakes at one corner of the field and then with aid of the square put out two lines of stakes—the stakes being placed at the distances it is desired to plant the trees—so that they intersect at right angles at the point of the square. Then move the square to the last stake in one of the lines, and place it so that one of the sides of the square is exactly in the line and that the other side points towards the field. Now sight and stake off another line along this side of the square and again move the square to the last stake in the line last staked and proceed with the staking as already described. If the work has been carefully performed, the first and the last staked lines should meet each other at right angles, which may be ascertained by placing the square in the fourth corner. The rest of the staking of the field with the aid of the wire previously prepared is now a simple matter. Stretch the wire across the field, beginning at the first corner between the stakes that are opposite each other, and drive a stake into the ground beside each mark on the wire; when the line is staked move the wire up to the next two stakes opposite each other and proceed until the entire field is staked.

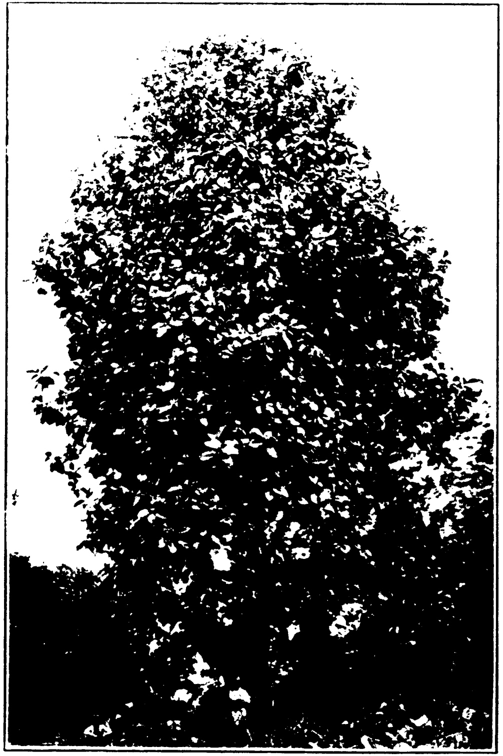
Before digging the holes, make a planting board (fig. 47) about 2 meters in length, and place the board so that the tree stake fits into the central notch, and drive a small stake in each notch at the ends of the board; then remove the central stake and dig the hole. In planting the tree replace the board so that the two small stakes fit into the end notches and plant the tree so that it fits into the middle notch. Thus the planting board places the tree in the exact position of the stake and also guides the planter as to the proper depth to plant.

The holes should be dug sufficiently large so that in planting the tree the roots can spread out in a natural way; they should never be forced into a small hole. If the roots are bent into an unnatural position they become incapable of anchoring the tree sufficiently to withstand typhoons. It is also well to bear in mind the fact that many species do not succeed well if planted too deep; therefore, generally speaking, no plants should be set deeper than they grow in the nursery, and when it is taken into consideration that the soil around a newly planted tree always settles more or less, it is best to set out the plants so that the crown roots are 3 to 5 centimeters above the general level of the land. Surface soil should always be used in filling the hole

PLATE XVI



(*a*) Bauno in Basilan, a fruit tree of majestic habit adapted to humid regions



(*b*) Marang in Basilan, an ornamental fruit tree adapted to humid regions

and it should be carefully worked in among the roots, leaving no air spaces.

Where the dry and rainy seasons are well marked, the trees should be planted with the arrival of the first rains, since no watering will then be necessary, and they will establish themselves with less difficulty and with less expense to the planter than if they are set out later or during the dry season. If the planting is performed during the dry season a good-sized basin should be made around the plant and one to three or more buckets of water applied, according to the size of the tree; after this put a thick mulch around the tree to protect the soil from evaporation. Liberal applications of water should thereafter be given to the tree, from time to time, whenever the soil dries out, until the plants are well established. (Plate XIV).

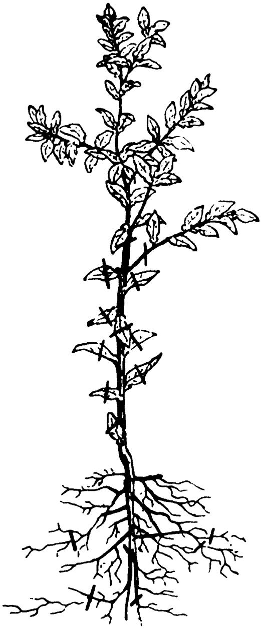


FIG. 44. Manner of pruning a tree preparatory to planting in the field

Before the plants are dug up from the nursery for transplantation to the field, about one-third of the growth and most of the foliage should be pruned off in order to prevent excessive evaporation before the plant has become established in its new location; all injured and straggling roots should also be pruned away (fig. 44).

Great care should be exercised in the transfer of the plants from the nursery to the field so as to avoid the drying out of the roots, for this causes a correspondingly great delay in the recuperation and growth of the plant. As far as possible the plants should be dug so that a ball of soil adheres to the roots. Particularly where the soil is sandy and loose in the nursery, and falls away from the roots in the course of digging, the plants should be well shaded by covering them with wet grass or straw which should be wetted down from time to time as it becomes necessary until the plants have been set out.

Papayas are usually and best transplanted to the field from the nursery when they are small plants, ten to 15 centimeters tall, and it is not generally known that plants 1 to more than 2 meters tall may be safely transplanted without a cumbersome ball of soil, though this is necessarily more expensive. It may be accomplished, however, by the simple expedient of trimming off the leafblades, leaving the long petioles to adhere to the stem, as shown in fig. 45. Thus the petioles dry up and fall off and a good leaf-scar is formed before the fungi have time to invade the stem from the petioles, which happens if the plant is improperly pruned, in which case the plant usually dies. The trans-

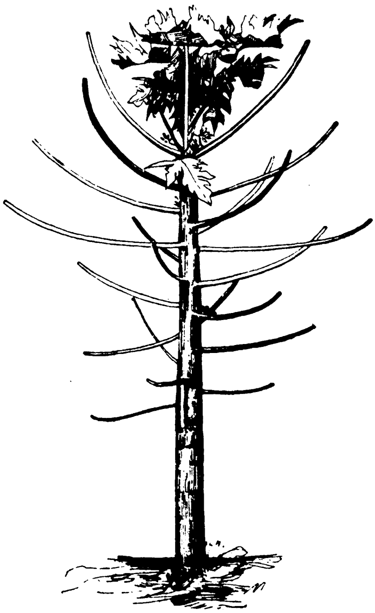


FIG. 45. Papaya properly pruned preparatory to transplanting

plantation of large papaya trees should never be done during the rainy season.

CULTURE

In a young orchard, at the end of the rainy season the growth of the cover crop may be piled around the trees for mulch or plowed under and vegetables or some other short-seasoned crop planted. In an orchard of bearing trees it is best to allow the land to lie fallow during the ripening and harvesting of the fruit and plant the subsidiary crop after the fruit is gathered.

Where the land is to lie fallow during the dry season, in those districts where this season is prolonged and irrigation is impracticable, the soil should be hoed around the trees and the loose weeds and trash piled about them, the middles plowed to a depth of about 10 centimeters and the soil finely pulverized by harrowing. Shallow harrowings should of course be repeated at intervals of three to four weeks during the dry season. The resultant soil mulch provided around the trees by the hoeing, supplemented by the vegetable mulch of the previous season's cover crop, and aided by the repeated shallow cultivations, will serve to preserve the moisture more effectually than could be done in any other way.

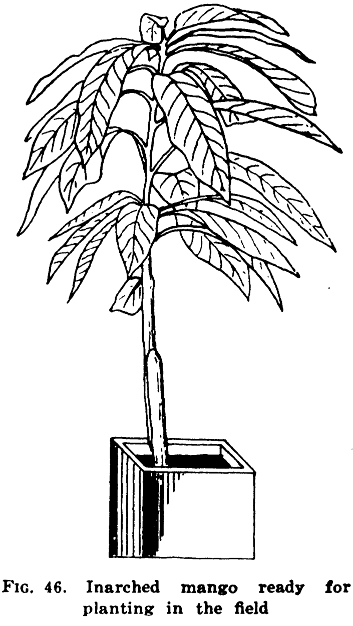


FIG. 46. Inarched mango ready for planting in the field

At the end of the dry season, whether the land has lain fallow or been planted to annual crops, the space between the rows should be given a deeper plowing of from 15 to 30 centimeters. This is done in order to assist the trees in the formation of a deeper root system, which again assists the trees in resisting the evil effects of a prolonged dry period. The depth of this plowing should vary from year to year, say, 15 centimeters one year, 20 centimeters the next, 25 centimeters the third, and 30 centimeters the fourth year. Then begin again with a depth of 15 centimeters.

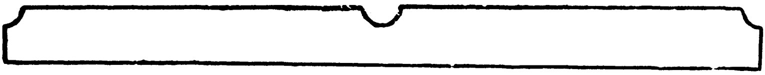


FIG. 47. Planting board

Great care should always be taken to see that, in the course of their cultivation, the trees are never injured either by the work animals or the implements. A short whiffle-tree should be used and, as a further precaution, the ends of the whiffle-tree and the traces by which the cultivator is attached to the animal—when these consist of iron chains—should be wound with burlap.

PRUNING

Every fruit grower should possess a set of pruning tools (fig. 7) consisting of a pruning knife, pruning shears, pruning saw, and a tree pruner for tall trees. Good tools are necessary in

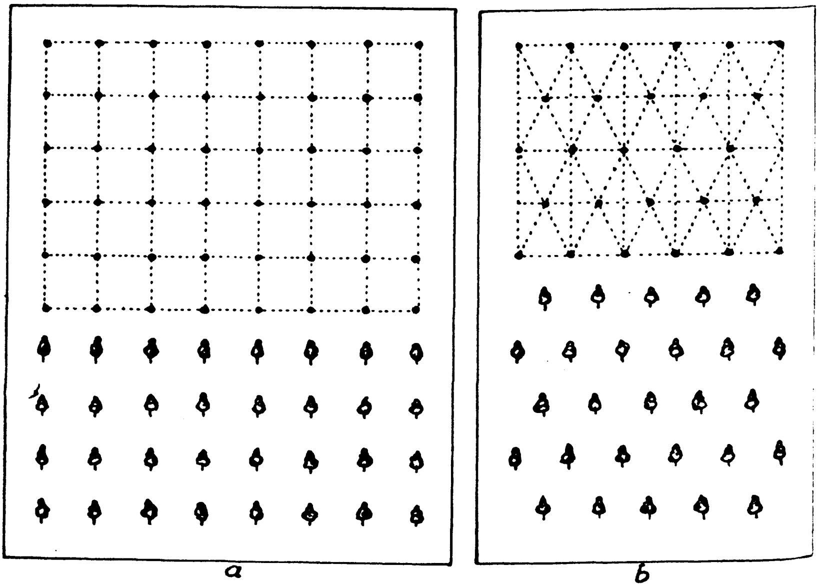
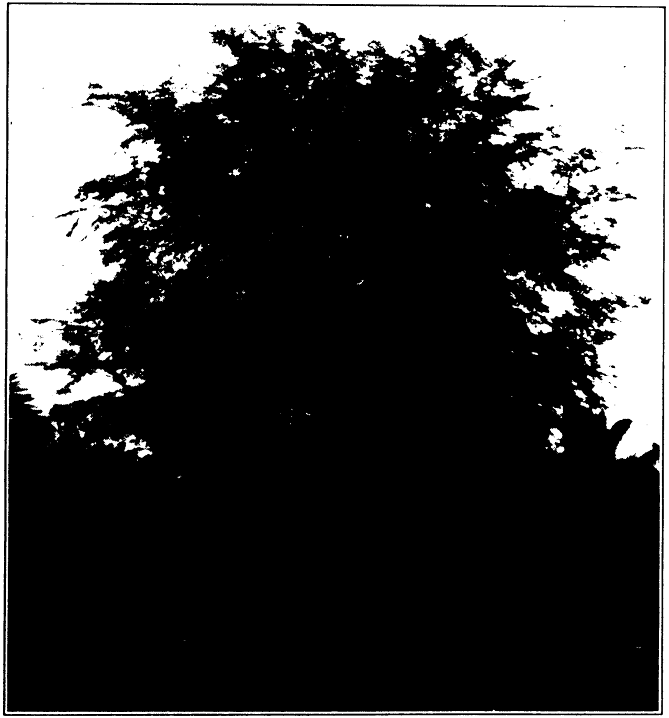


FIG. 48. Diagrams illustrating (*a*) the square, and (*b*) the hexagonal system of planting



(*a*) The Tamarind. A fruit tree of exceptional merit as a shade tree

(*b*) The Kayam: a good nut bearing shade tree adapted to humid regions

order to perform the pruning properly and if the local stores do not keep tools of good quality, it is best to write for such to a reputable seed house in Europe, the United States or Australia.

In order to produce the best results, most temperate fruit trees are pruned annually. The tropical fruits, broadly considered, have as yet been too insufficiently studied to warrant any sweeping recommendations relative to pruning to increase fruit production, but, generally speaking, it is the opinion of the author that the productivity of most tropical fruits that have come under his observation are little if at all increased by pruning.

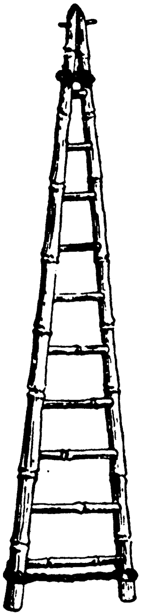


FIG. 49. Home made bamboo ladder for use in pruning and gathering fruits

In those species where the flowers issue from the terminal buds, as in the mango, the avocado or some of the Eugenias, or where the flowers appear on the young growing wood, as in the guava, the fruitfulness of the tree is reduced rather than increased by pruning. Aside from this, the danger from sunscald of stem and branches must be considered in countries where light and sunheat is intense. In this connection it is worthy of notice that most tropical trees carry more luxuriant foliage than those of the Temperate Zone. The pruning should therefore be limited to the removal of dead, dying or severely insect-infested branches and to the pinching back of the young growths, so as to make a well-balanced tree, and to the cutting out of interlocking branches that injure each other when moved by the wind—those instances excepted, of course, where the grower knows that the pruning is beneficial.

The rapid healing of the wound, so as to prevent the entrance of fungi or borers, necessitates a smooth cut. No stubs should

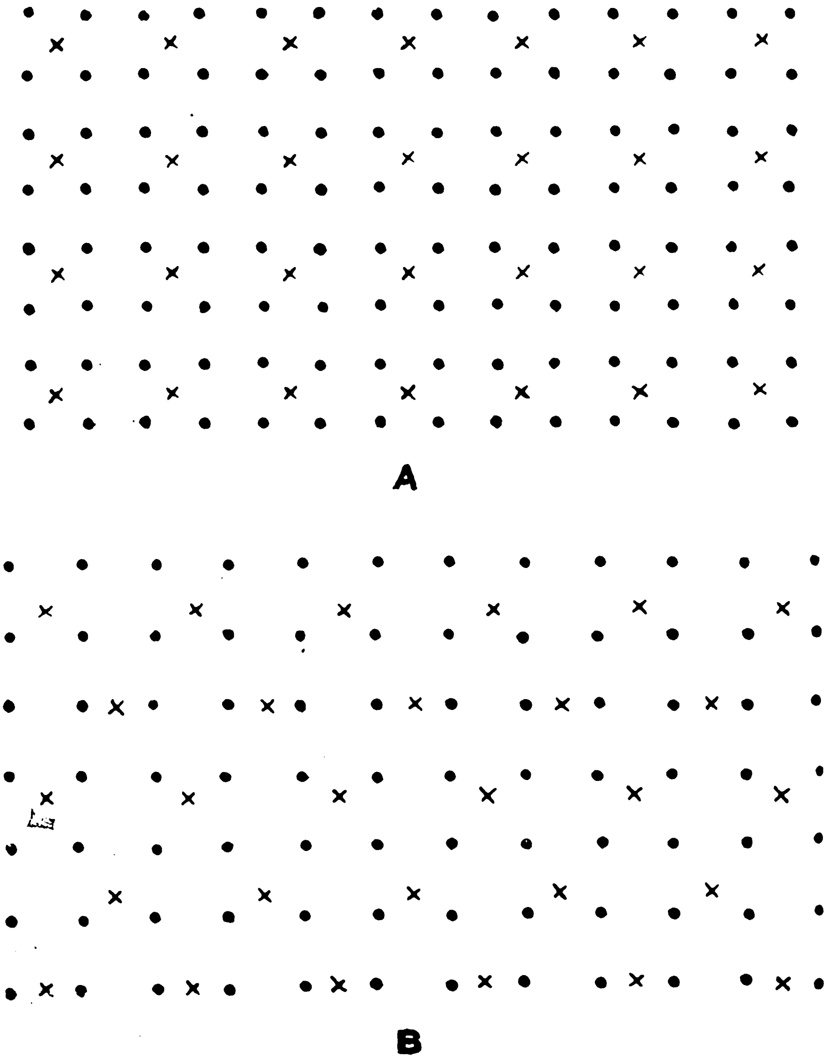


FIG. 50. Diagrams illustrating the planting of shade trees among coffee: (A) Coffee spaced 2.5 meters apart; (B) Coffee spaced 3.5 meters apart. The dots indicate coffee trees, the crosses indicate shade trees, *Leucaena glauca*

be left, and the cuts should therefore be made as close as possible to the remaining part of the tree. In order to do this the pruning shears should be held so that the blade is nearest to the tree in the act of pruning, and not vice versa (figs. 51 and 52). The pruning knife should be used for small twigs and to smooth the cuts made by the saw or the shears; the pruning shears should be used in pruning heavier branches, and the saw should be employed for removing branches and limbs too large for the shears. The long-handled tree pruner (fig. 7, d) is used in pruning the tops of large trees. All pruning should be done during the dry season, and all cuts of any considerable size should be painted with white lead, linseed oil or coal tar, applied to the wounds at the time of pruning. Do not apply so much paint or tar that it runs down the limb. Large branches should be pruned so that the cut surface slopes sufficiently to shed rain and dew.

All prunings should be gathered and piled up in heaps and burned at once to prevent the possible spread of diseases and the migration of insect pests from the prunings to the trees. If they are left to decay they are sure to provide an excellent breeding place for borers, which subsequently find their way into the orchard. The ashes may to advantage be spread about the trees.

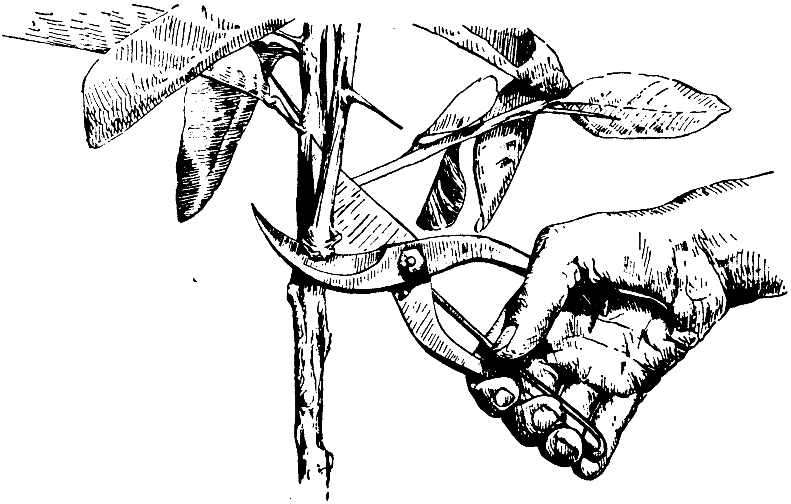


FIG. 51. Proper way to hold the pruning shears

SECONDARY CROPS

In a young grove with small trees and considerable vacant space between the trees this space may be utilized to advantage for secondary or cover crops, such as camotes, cassava, corn, yams, upland rice or vegetables, provided that they are not planted so close to the trees that these are crowded by them or injured in the course of their cultivation and harvesting.

Similarly, pineapples may be interplanted with young fruit trees with the view of removing them when the trees grow larger, by which time the pineapples will be found to have paid well for the cultivation of both themselves and the trees, and to have left a handsome profit besides. In fruit orchards where the spacing of the trees is 6 meters or more, papayas may be interplanted with the newly planted trees, and bananas may be interplanted where the permanent trees are spaced 10 meters or more apart, of course with the expectation of removing them as the trees require more room. In orchards where the permanent grove consists of large growing trees requiring extra wide spacing, such as mangos, avocados, breadfruit, etc., quick-growing and small trees that come early into fruiting may be interplanted with a view of removing them later.

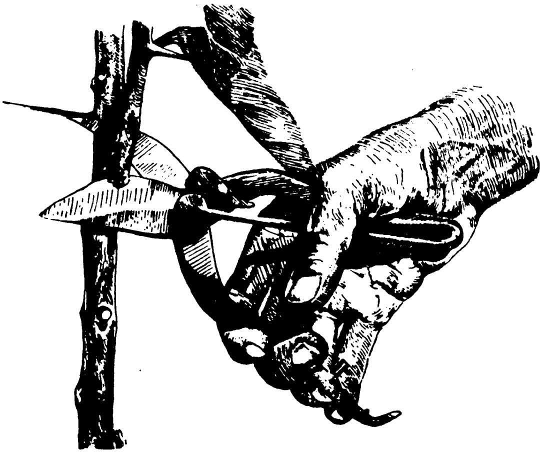


FIG. 52. Wrong way to hold pruning shears

If nothing else is grown on the land it should at least be sown to some leguminous cover-crop, such as the cowpea, mungo, guar, cadios, medeloa, and the Lyon bean or related legumes that succeed well in the locality in question. Excepting the Lyon bean and its congener,[1] and cadios, which fruit best when sown with the expectation of a season's growth during the rainy season, the legumes mentioned, while making

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[1] A closely related plant.

(*a*) Field of pineapples. Lamao Experiment Station

(*b*) Cinchona Plantation in Java, illustrating terracing and showing the planting of Cinchona in the fore ground; old cinchona trees in the rear

good growth during the rainy season, fail to seed unless sown and harvested during the dry season.

WINDBREAKS

Where the natural growth on the land is sufficiently robust to serve this purpose, an excellent windbreak is already provided for the grove merely by leaving this growth undisturbed around the orchard. If the orchard is located in an open wind-swept country, windbreaks should be established by planting around the orchard strong-growing trees that have a good root system and are therefore not easily uprooted, or whose tops are not easily damaged by strong winds. As far as possible, fruit trees should be utilized in planting windbreaks. The mango, bauno, tamarind, huani and mabolo make excellent windbreaks. The bamboo, so useful in the Tropics, is unexcelled for this purpose.

Simultaneously with the planting of the orchard, the windbreaks should also be planted all round the field; the plants in windbreaks should be put rather close with the view of thinning them as they grow larger. If the orchard is large and much exposed it may be found desirable to plant several rows of trees as windbreaks here and there in the orchard. These should be planted at right angles to the most prevailing winds in order to be most effective.

SHADE TREES AND ORNAMENTAL PLANTS

Desirable everywhere, nowhere are shade trees along the roadsides and around the home so grateful as in the Tropics.

In the house yard, fruit trees should be planted for shade as a matter of course. In selecting shade trees for roads and streets the following points should be considered.

1. The general adaptability of the tree to the soil and climate
2. Utility for shade
3. Ability to withstand damage by the wind
4. Immunity from insect pests and diseases
5. Attractiveness
6. Longevity
7. Economic value
8. Rapidity of growth
9. Size (in relation to the width of road)

In planting shade trees for the road, the primary object is of course to provide shade, and usually the trees planted for this purpose have no other value. There is no good reason, however, why fruit-bearing trees should not be utilized as shade trees and thus be made to serve two purposes, having always in mind that the chief object is to provide shade. For roads and wide streets, evergreen trees should of course be planted, such as the mango, tamarind, mabolo, bauno, marang, etc., but for narrow streets palms are more suitable. (Plates XV*b*, XVI and XVII).

For the best scenic effects, trees of a single species should always be planted in a continuous file for a long stretch of road. The alternation of trees of different species in an avenue should never be permitted and it is here as incongruous as would be, for instance, different designs in the columns of a colonnade. It is continuity of design and its replication in one tree after another that in this phase of landscape architecture produces the beautiful effects admired in a well-executed and properly cared-for avenue (Plate XX). Also, for the best effects, shade trees should be so selected and planted according to the width of the road that when the trees attain their ultimate size the crowns do not quite grow together.

The following fruit trees growing in the Philippines are also well adapted for planting as shade trees along roads and drives. They should be set out at the distances indicated:

	Meters.
Alakao	13–18
Aluao *	12–14
Bachang	13–18
Bageja *	12–15
Bauno *	13–20
Date	8–10
Hondapara	12–15
Huani *	13–18
Kanari *	12–15
Katmon *	12–14
Kayam *	13–18
Mabolo	12–14
Mamey	14–20
Mango	14–20
Marang *	14–18
Inogug *	14–20
Santol	14–18
Tamarind	14–20
Tersana *	11–13
Paho	13–18
Pili *	12–15

Indeed, the trees may be spaced still farther apart without

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* Adapted to humid regions with rainfall of equal distribution throughout the year, and no long dry periods.

Plantation of Robusta coffee in Java illustrating manner of shading and topping the coffee. The shade trees are Leucaena glauca

detriment to the general decorative effect, though as a rule they should never be so widely spaced that when they are full grown their tops would be more than 8 meters apart.

The trees *not* asterisked will of course make a satisfactory growth as shade trees in the moist regions but do not fruit as well there as in districts having a pronounced and rather prolonged dry period. The mango, especially, is noted for its failure to fruit in humid districts.

The following species are especially recommended as ornamental shade trees where fruit trees are not desired. Several of these are also valuable for their timber:

Calophyllum inophyllum L.	PALO MARIA
Cassia siamea Lam.	ACACIA
Casuarina rumphiana Miq.	AGOHO
—— *equisetifolia* Forst.	AGOHO
Eucalyptus robusta Sm.	SWAMP MAHOGANY
—— *naudiniana* Muell.	DINGLAS
Ficus nitida Thunb.	LAUREL CUBAN
—— *religiosa* L.	PEEPUL
Filicium decipiens Thw.	
Grevillea robusta Cunn.	SILKOAK
Myroxylon toluiferum H. B. K.	
Oreodoxa regia H. B. K.	ROYAL PALM
Peltophorum inerme Naves.	IYAVAKI
Phoenix canariensis Hort.	CANARY ISLAND DATE
Pithecolobium saman Bth.	GUANGO
Pterocarpus indicus Willd.	NARRA
Syncarpia glomulifera Ndz.	TURPENTINE TREE
Terminalia belerica Roxb.	DJALABI

Among those species *Casuarina rumphiana* and *Grevillea robusta* should not be planted below an elevation of 350 meters. *Calophyllum inophyllum* and *Casuarina equisetifolia* are especially well adapted for planting in exposed situations near the seashore where few trees succeed well. *Ficus nitida* succeeds well even where the dry season is pronounced, but *Ficus religiosa* does the best where the rainfall is of equal distribution. Under such circumstances the Narra is unsurpassed as a shade tree.

Deciduous trees such as the "Fire tree," *Delonix regia, Albizzia lebbek,* "Kupang," *Parkia timoriana,* or "Talisay" *Terminalia catappa,* should never be utilized as shade trees for roads since they always shed their foliage during the hot, dry season when shade is most appreciated.

The best effects from shrubs are generally attained by massing them in groups. While solitary shrubs are permissible now and then, the lawn should not be cluttered up by a large number of individual shrubs set out promiscuously here and there. Intricate and peculiar designs of shrubbery and flower-beds should be avoided. Simplicity and naturalness should be the keynote in all plans.

Though judicious pruning frequently serves to bring out the full beauty of ornamental shrubs and trees, the pruning saw and shears should be used with caution among decorative plants else the over-assiduous employment of those implements is apt to express itself in the painfully grotesque and vulgar effects that are all too frequent in the parks and gardens in the Tropics—affronts alike to nature and art.

A hedge may still remain serviceable, but it ceases to be attractive when modeled along geometric lines, with sharp corners, by frequently repeated trimmings. Most birds are attractive and many are exceedingly beautiful in the original but a shrub wrought into the image of one is always ugly and borders on the ridiculous. Clean-cut lines in well executed stonework are pleasing to the eye, but shrubs and trees fashioned into pillars, posts, stone walls and whatnots are unattractive and commonplace to say the least.

Formal gardening may be, and frequently is, an exhibition of great manual skill, but it is also an exposition of freakishness, and shows a lack of appreciation of true beauty. In the Tropics with their luxuriant, opulent vegetation formal gardening is especially out of harmony with the natural surroundings.

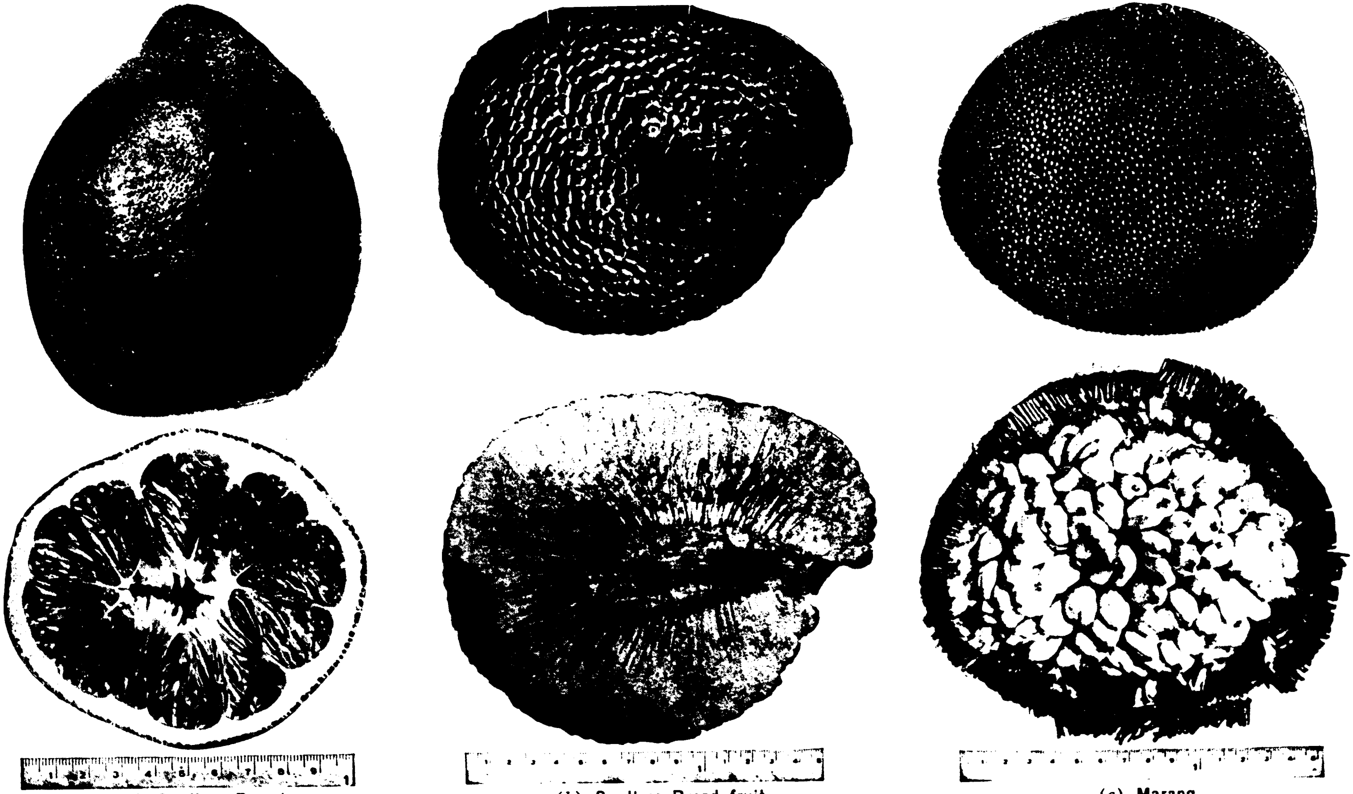
In the ornamentation of parks, squares and streets in the city or country village, or in the planning of an estate or the yard around the house, utility and appropriateness of every object planned for should always be obvious. There should always be a reason for a walk here, an open vista there, or a group of shrubbery yonder. It should be remembered that an object that serves no purpose is out of place and that, if all is harmoniously and tastefully arranged, no single feature should glare conspicuously in the face, but that the whole should give an impression of completeness that would be lost by the removal of any one part.

PLANT PESTS

PRELIMINARY REMARKS

An extended discussion of plant pests would be beyond the scope of this publication, but it may perhaps be well to make a brief reference to the more common ones and recommend a few easily applied remedies. It should be remembered that "an

PLATE XX



(*a*) Seedless Pomelo

(*b*) Seedless Bread fruit

(*c*) Marang

TROPICAL FRUITS OF MERIT

ounce of prevention is worth a pound of cure," which in this instance usually means having strong, vigorous plants—obtainable by strict attention to their wants.

PLANT PARASITES

There are several species of *Loranthus* which are parasitic on many fruit trees in the Philippines and the oriental tropics generally, such as the mango, citrus fruits and lanzon. The seeds of these plants are very small and light and are carried by the wind and deposited in the forks of twigs and branches, or caught in crevices in the bark, where they germinate. As the plants grow the roots penetrate the bark and even into the wood itself from which they draw their sustenance. These plant parasites drain the vitality of their hosts and occupy space that should be occupied by the branches of the tree. They rarely kill the plants upon which they grow but greatly impair their vitality at the expense of their normal development and fruit production.

In order to prevent parasites of this kind to establish themselves in the fruit orchard, this should be inspected annually and all plant parasites pruned out.

If Lichens become troublesome on the trunks and branches they should be removed with a scraper and the trunk sprayed with a solution of copper sulfate. Bordeaux mixture will also serve the purpose.

DISEASES

DAMPING OFF

Sclerotium sp.

Damping off is the most serious trouble in the seedflat or seedbed, attacking the plants shortly after they have appeared above the ground, while they are still brittle and tender. It is caused by excessive watering, and the remedy consists in pulling out all affected plants and allowing the seedbed to dry out.

CITRUS CANKER

Pseudomonas citri

As happened in several other countries this disease was in the Philippines at first confused with scab, *Clasdosporium citri* until it was closely studied.

Like the scab it is readily recognized by the rough, corky elevations that appear on the twigs, leaves and fruit. The citrus fruits are very variable in their susceptibility to the citrus canker both as regards species and varieties within a species. Experiments for the control of the canker by the means of spraying and pruning are in progress. Whatever value these methods of control may have, at present it would appear that the most practicable method of handling the citrus canker situation in the Philippines is to confine the planting of varieties and species to those that are resistant to the canker. The mandarin, tizon, kalamondin and lemon are quite generally free from canker, and there are varieties of the pomelo, orange, lime and kalpi that are very resistant.

In the nursery repeated sprayings with Bordeaux mixture is an effective remedy for citrus canker.

Scab, *Cladosporium citri* has not been reliably reported from the Philippines.

PINK DISEASE

Corticium salmonicolor

This fungus attacks the twigs and stems, which it girdles, of various species of fruits, including the citrus fruits and several of the important economic tree crops like rubber, tea, cacao and cinchona.

Recent experiments made by Lee and Yates at the Lamao experiment station have shown that pink disease can be controlled by the employment of fungicides. Lime-sulfur wash (formula No. 5) has been found the most desirable.

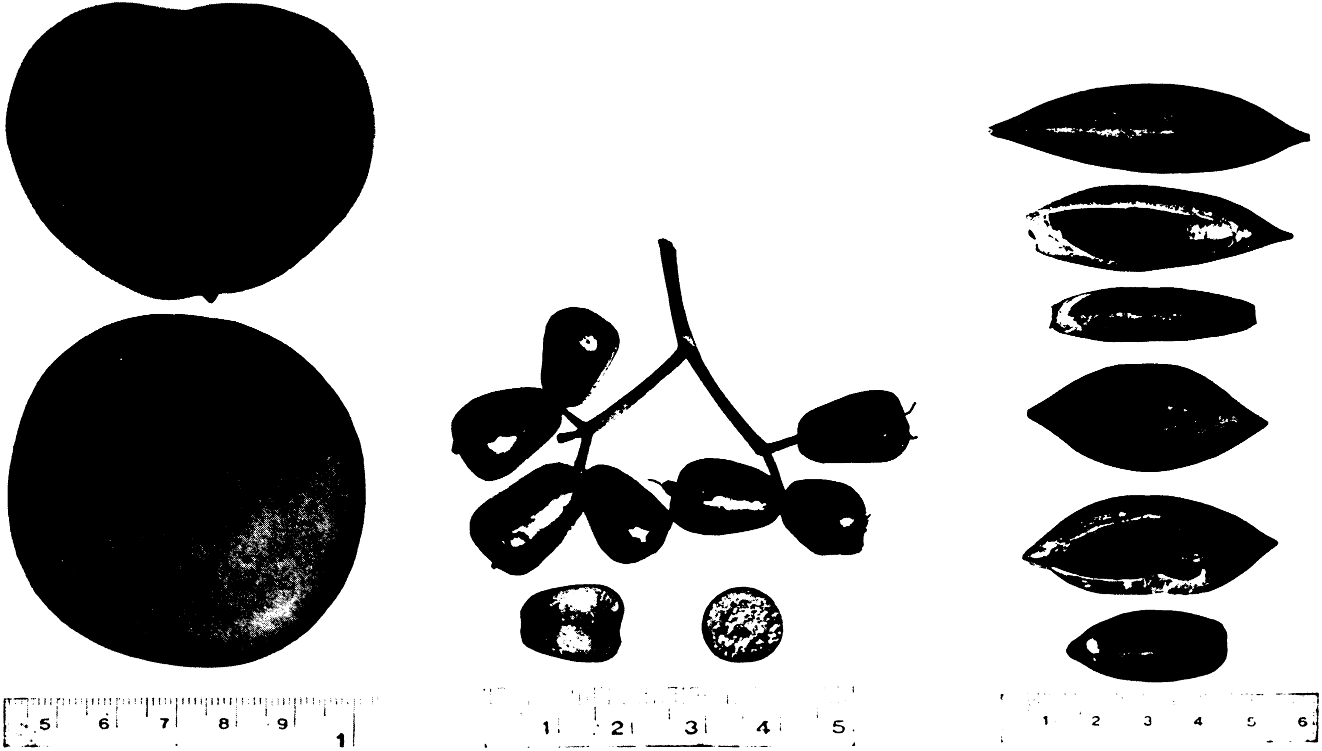
The more seriously affected parts of the plant should be pruned away, removed and burned.

BARKROT

This is by far the most serious trouble of the citrus fruits in the Philippines. It appeared first in the mandarin district where practically all old trees were affected. A large majority of the trees are now already dead or dying.

The oozing out of sap and the formation of a putrid sore on the trunk or larger branches is the first indication of barkrot. These sores enlarge to the size of a 10-centavo piece and sometimes girdle the entire tree. After the disease has progressed for several months the sores dry up, the bark on the affected areas sheds off, and the trees are left in a very much weakened condition, sometimes succumbing after the first attack, though it usually requires one or more repeated attacks to kill the trees.

Since the causative agent is not known, recommendations must be merely suggestive and in line with general plant sanitation.



(*a*) Seedless Mabolo

(*b*) Seedless Duhat

(*c*) The Pili

TROPICAL FRUITS OF MERIT

Dead trees, those beyond recovery and all dead branches on trees less affected should be removed an burned.

On trees worth saving the sores should be cleaned out and painted with a mixture of crude carbolic acid and water in equal parts, but great care should be taken not to apply so much of the mixture that it would run down on healthy tissue and would destroy it.

Then the weeds should be cut and the land plowed and harrowed, care being taken not to plow too near the trees.

INSECT PESTS

SUCKING INSECTS

Everything considered, the sucking insects, consisting of several species of Aphis, mealy bugs, thrips, scale-insects and the red spiders, are the most serious insects pests that the nursery-man has to contend with.

The aphids are small, greenish, brownish or black, gregarious, soft-bodied insects with an enormous capacity for reproduction. Here in the Philippines predaceous insects occur in sufficient numbers to keep the aphids fairly well in check, and they do comparatively little damage. They may, when abundant, be easily destroyed by the use of any of the contact sprays, such as whale-oil soap, kerosene emulsion, or tobacco water (formulas Nos. 2, 3, and 9). They may also be killed by the use of tobacco dust, which should be applied to the plants when they are wet with dew.

The mealy bugs are brownish, soft-bodied insects, 2 or more millimeters long and covered with a whitish, floury substance from which their name has been derived. Because of this protection, sprays are ineffective against them unless applied with sufficient force to penetrate the mealy covering and come in contact with the body of the insect. Most species of the mealy bug live in symbiosis [1] with various species of ants which carry them from plant to plant. Generally speaking, there are sufficient predaceous insects here to keep the mealy bugs under control when they occur on large plants before they increase to a point where they become a menace. Sometimes it may be found more expedient, however, to destroy them by a spray than to await the arrival of their enemies. The worst infested parts of the plants should then be pruned away and the plant sprayed thoroughly with kerosene emulsion, resin wash, or kerosene-carbolic-acid emulsion. All ant nests in the ground should be destroyed by the use of scalding water or carbon bisulphide, or kerosene-carbolic-acid emulsion should be sprayed into the nests. Do not apply hot water to the roots of plants.

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[1] The living of two dissimilar animals or two dissimilar plants each dependent upon the other.

Where, in the nursery, the mealy bugs attack very young and tender plants which are easily injured by insecticides it is best to kill them by hand.

Thrips are small, slender, greenish or black sucking insects that sometimes do considerable damage in the nursery if once they become established and nothing is done towards their control. They live on the underside of the leaves of many plants, and the spray should therefore be directed upwards in the act of spraying in order to be effective. The thrips may be successfully combated with the same insecticides as are recommended against the aphids.

The red spider, a very small mite, barely visible to the naked eye, and related mites, also cause considerable injury if no steps are taken towards their eradication. They are, however, easily controlled by simply spraying the plants with water under fairly strong pressure from the garden hose, or they may be eradicated by the same insecticides recommended for the thrips.

The scale insects, because of parasitic and predaceous insects and parasitic fungi, do not seem to be a very serious menace to the Philippine nurseryman and fruit grower. Wherever they become troublesome, they may be sprayed with any of the following formulas: Nos. 2, 3, 4, and 5.

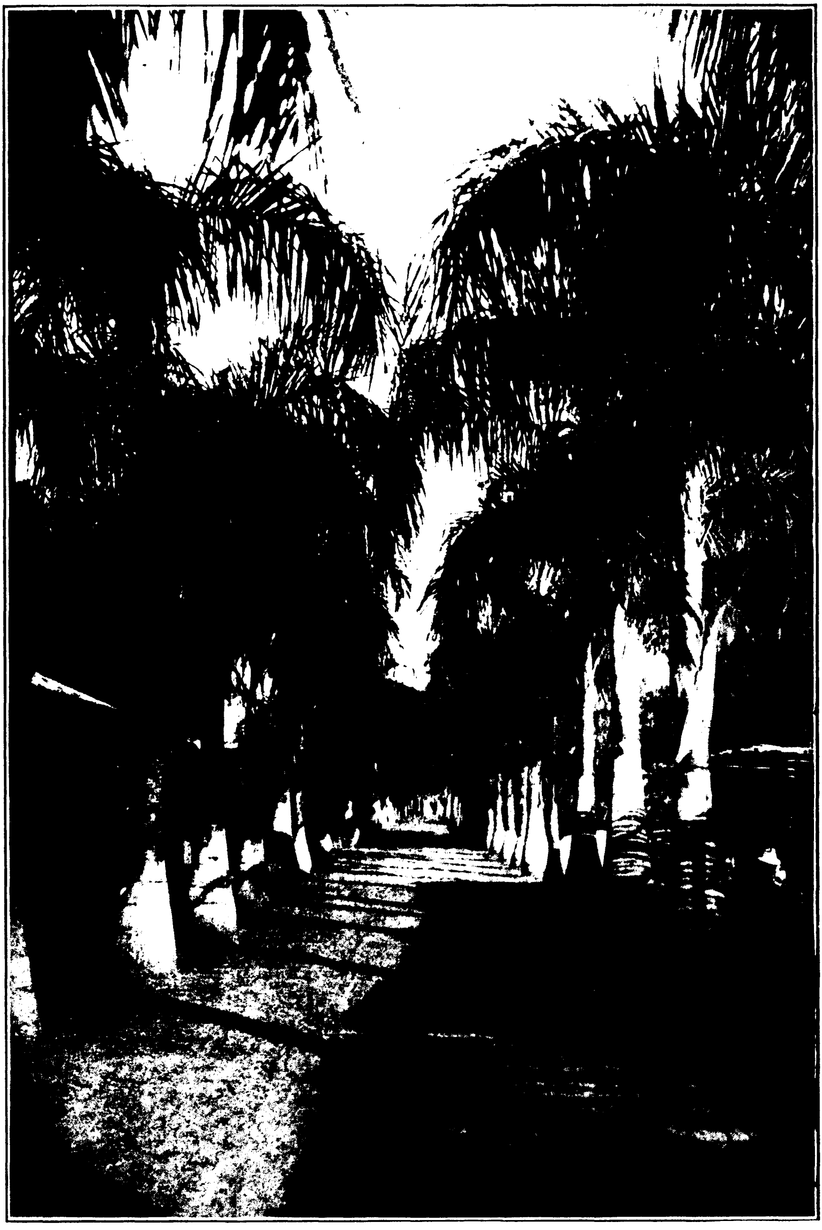
BITING INSECTS

Cut-worms and other leaf-eating larvae, which attack very tender plants likely to be injured by sprays, should be handpicked. Where a spray may be safely used, arsenate of lead or Paris green may be applied as recommended in formulas Nos. 7 and 8.

BORERS

There are numerous beetles in the tropics which are very destructive in the larval stage. Some species tunnel in the wood, in the twigs and trunks, while other species confine their activities to the bark of trees.

Prunings and dead branches should never be allowed to accumulate in the orchard but should be promptly removed and burned. As a protective measure against borers which attack the trunk and larger branches, those parts of the tree may be painted with plain white wash (quicklime and water) or white



The Royal Palm as an avenue tree, Lamao Experimental Station

lead. Borers which have already found their way into the tree should be killed.

FRUIT FLIES

Fruit flies to some extent may be controlled by collecting and burning all drops and refuse fruits, and by the application of poisoned bait to the trees (formula No. 10).

ANTS AND TERMITES

Various species of ants make nests in the trees by gumming and spinning the leaves together in large nests. Some of these ants distribute scale insects, and others are so large and warlike that their presence is altogether undesirable. Ants of this type are best controlled by burning them out by a kerosene torch.

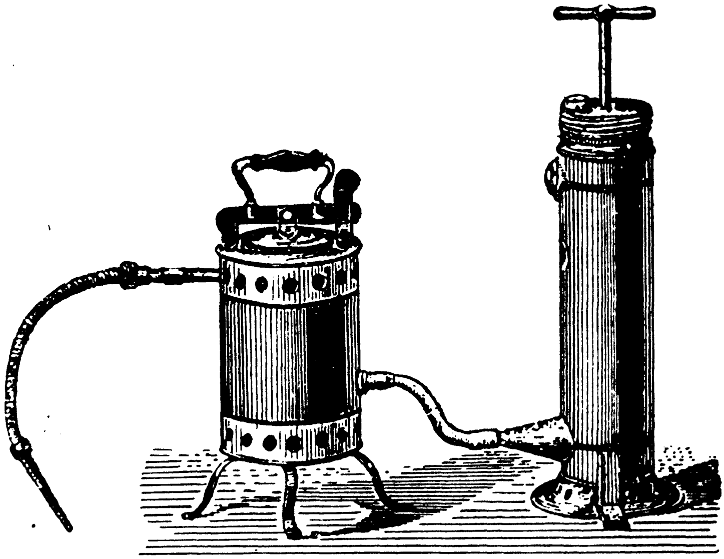


FIG. 53. Ant exterminator.

Ants which make their nests in the ground are best controlled by spraying into their nests formula No. 6.

Termites or white ants frequently are very troublesome but may be destroyed by pouring carbon bisulfide into their nests through holes made by a crowbar and then closing the holes with clay, or they may be killed by pumping arsenic and sulfur fumes into their nests by means of an ant exterminator. This apparatus (fig. 53) consists of a combined charcoal burner and fume chamber, and a hand pump connected by a rubber hose. About a heaping spoonful of each, sulfur and arsenic, is sufficient to treat a termite nest of ordinary size. After the burner is lighted the air is pumped into the fume chamber, from which the charge of poisonous gas is forced into the termite nest. Pumping for about 5 minutes suffices to introduce a sufficient volume of the gas to kill the insects.

SPRAYING

In order to be effective, the spraying should be thorough and the application liberal, and the pressure should be sufficient to cause the spray to settle on the plants as a fine mist and not in large drops.

The "Vermorel" is preferable to other types of nozzles.

It is important that the spray mixture be well strained in order to prevent the nozzles from becoming clogged in the act of spraying. It is also well to remember that *the copper sulphate and the arsenates are very poisonous and should not be left where they are accessible to children or domestic animals.*

The arsenical sprays are employed in the destruction of biting insects that eat the poisoned leaves; the oily sprays, or those containing sulphur, are commonly referred to as contact sprays because they kill the insects by contact. Therefore it is very important that the latter class or spray be applied *to the insects the destruction of which contemplated,* as the spraying of the plants themselves is ineffectual. It is good practice, before the spray is applied to large trees, to throw a few shovelsful of earth about the trunks of the trees to prevent the spray from seeping in around the roots. When the spraying is completed, rake away the earth.

Thoroughly rinse out the spraying implements with clean water when the spraying is completed.

FORMULAS FOR FUNGICIDES, INSECTICIDES[1] AND HERPICIDES

No. 1. *Bordeaux mixture*

FOR FUNGI

Copper sulphate	kilograms	1.5
Unslaked lime	do	1
Water	liters	100

Place the copper sulphate in a feed sack and suspend it in a barrel containing 50 liters of water so that the sack is entirely covered by water. Slake the lime in another vessel and, when slaked, dilute to 50 liters. Before mixing, stir the two solutions vigorously. Then dip up a bucketful from each solution and pour the two liquids together into a spray barrel, at the same time agitating the mixture vigorously. An excess of copper sulphate is injurious to the foliage, and, before spraying, the mixture should therefore be tested. This is done by inserting and holding in the mixture a clean steel blade for one or two minutes. If copper is deposited on the blade, more lime must be added. Use the mixture at once.

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[1] Any of the nonarsenical sprays may be rendered effective against biting insects by adding to them Paris green or arsenate of lead at the same rate as recommended in formulas Nos. 7 and 8.

No. 2. *Good's caustic-potash whale-oil soap*

FOR SCALE AND SUCKING INSECTS

Whale-oil soap	kilograms	3–6
Water	liters	100

Dissolve the soap in cold water, strain and apply.

No. 3. *Kerosene emulsion*

FOR SCALE AND SUCKING INSECTS

Kerosene	liters	7.5
Hard soap	kilograms	.25
Water	liters	4

Dissolve the soap in boiling water and, while still hot, add the kerosene. Churn the liquid steadily for fifteen or twenty minutes by using a force pump, the liquid being pumped back into the vessel until it is emulsified. Sufficient hot water should be added to increase the volume of the solution to 16 liters. For spraying, dilute at the rate of 1 liter of the stock solution to 15 to 20 liters of cold water.

No. 4. *Resin wash*

FOR SCALE AND SUCKING INSECTS

Resin	kilograms	9
Caustic soda (98 per cent)	do	2.25
Fish oil	liters	1.5
Water	do	75

Pour 75 liters of water over the resin (which should be well broken up), caustic soda and fish oil in a large iron kettle, and boil for three hours. Then add hot water from another boiler (which should be provided for this purpose) from time to time, and stir thoroughly until there are 190 liters of the solution. If desired for immediate use, dilute each liter of the solution with 2 liters of cold water before using. If kept as a stock solution, it should be diluted at the same ratio when used.

No. 5. *Self-boiled lime-sulphur wash*

FOR FUNGI AND SCALE

Quicklime	kilograms....	3
Sulphur (flour or flowers)	do........	3
Water	liters....	100

Place the lime in a barrel and pour on enough water to cover it. When the lime begins to slake add the sulphur after running it through a sieve to break the lumps. Stir the mixture constantly and add water as needed to form a thick paste at first and then gradually thin it down. The lime will supply enough heat to boil the mixture several minutes. As soon as the lime is well slaked add water to cool the mixture and prevent further cooking. Strain carefully, working the sulphur through the strainer and dilute to 100 liters.

No. 6. *Kerosene-carbolic-acid emulsion*

FOR ANTS AND MEALY BUGS

Kerosene	liters....	15
Crude carbolic acid	do........	.9
Soap	kilograms....	.5
Water	liters....	7.5

Dissolve the soap in boiling water together with the carbolic acid and while still hot, add the kerosene. Churn the liquid steadily for fifteen or twenty minutes by the use of a force pump, as in making kerosene emulsion. For spraying, dilute each liter of the emulsion with 18 liters of water. In using this insecticide for ants, spray the liquid into their nests.

No. 7. *Arsenate of lead*

FOR BITING INSECTS

Arsenate of lead	kilogram....	0.5–1
Quicklime	do........	.5–1
Water	liters....	100

Slake the lime in a wooden vessel, dilute to 100 liters and dissolve the arsenate of lead in the liquid.

No. 8. *Paris green*

FOR BITING INSECTS

Paris green	grams....	60–120
Quicklime	kilogram....	0.5–1
Water	liters....	100

Place the lime in a wooden vessel and slake, dilute to 100 liters and add Paris green. London purple may be substituted for Paris green and is then used at the same rate. Both these poisons, particularly the Paris green, have a tendency to settle,

PLATE XXIII

Ornamental Gardening. A corner in the Plaza, Zamboanga, Mindanao

and the liquid should be kept in constant agitation during the spraying, else the spray from the bottom of the barrel may seriously damage the foliage while the remainder is useless.

No. 9. *Tobacco water*

FOR THRIPS, APHIS, AND RED SPIDER

Put a sufficient quantity of tobacco stems to soak in water, for twelve to twenty-four hours, to make the water assume the color of weak coffee. Strain and spray.

No. 10. *The Mally fruit-fly remedy*

FOR FRUIT FLIES

Arsenate of lead	kilogram	0.6
Sugar	do	7.5
Water	liters	100

Dissolve the arsenate of lead in a small quantity of water, dilute to 100 liters and add sugar.

The first application should be made a month before the presence of the larvæ in the fruit is expected and thereafter an application every ten to fourteen days is thought advisable, bearing in mind that the poisoned bait should be on the trees as long as the flies are present in the grove. About 1 to 1.5 liters of spray is sufficient for a tree of 6 to 7.5 meters spread. Apply the spray so that the liquid falls in small drops over and through the tree.

No. 11. *Arsenite of soda*

FOR WEEDS

Arsenite of soda	kilogram	1
Water	liters	40–70

Dissolve the arsenite of soda in a quantity of water proportioned to the hardiness of the weeds and spray.

If commercial arsenite of soda is not obtainable the arsenite of soda solution may be prepared as follows:

White arsenic	kilogram	1
Washing or sal soda	kilograms	2
Water	liters	8

Place the ingredients in a kettle and boil for 15 to 20 minutes or until the solution becomes clear. The clearing of the solution indicates that the proper chemical combination has been effected. Dilute at the rate of 1 part of the stock solution to 14 to 24 parts of water, according to the hardiness of the weeds and spray.

As with spraying insecticides the spray should be applied in a fine mist and not in such excessive quantities that it would run into the ground from the plant, as accumulations of arsenic are poisonous to plants.

LIST OF TROPICAL FRUITS, SPICES, AND BEVERAGE PLANTS IN THE PHILIPPINES

NOTE.—Those species marked thus (†) are believed to be indigenous to the Philippines; those marked with an asterisk (*) were introduced into the Archipelago not earlier than 1900, and with few exceptions are not found outside of Government institutions. The following abbreviations indicate the provincial dialects, English, Spanish and Spanish-Filipino. Many of those designated English are so by adoption from the languages of the various foreign countries to which the plants are indigenous. In a few species with unwieldy names, those have been abbreviated or contracted into more convenient ones for common usage.

B.	Bicolano	P.	Pampango
Bu.	Bukidnon	Pa.	Pangasinano
D.	Davao	Sp.	Spanish
C.	Cotabato	Sp.-F.	Spanish-Filipino
E.	English	S.	Sulu
I.	Ibanag	T.	Tagalo
Il.	Ilocano	V.	Visayo
L.	Lanao	Z.	Zambaleño
M.	Moro	Za.	Zamboangueño
Mt.	Mountain Province		

Abihod, D. See Lanno
Abit, T. See Uay
Achiote, Sp.-F. See Annatto
Achuete, Sp.-F. See Annatto
† ADANG, I. *Eugenia calubcub* C. B. R.
Aduas, T. See Lamio
Afapúyan, I. See Banana
Afúyan, I. See Banana
Agas, T. V. (Applied to Alakao in Tagalo and to Kamiring in Visayo)
Agat, Il. See Ginger
† AGLAÑO, E. *Sapindaceae*
Agobakbak, Mt. See Adang
Agubak, T. See Kalapi
* AKEE, E. *Blighia sapida* Koen.
† ALAGA. *Uvaria sorsogonensis* Presl.
Alagan, Mt. See Orange
Alakaak, T. See Alakao
† ALAKAO, P. *Palaquium philippense* C. B. R.
Alakap, T. See Alákao
Alauihau, V. See Lamio
† ALEMANI, Mt. *Vaccinium villarii* Vid.
Alimikin, Il. See Banana
Alingaro, T. See Lingaro
Alipay, T. See Alpay
Al-la-allayat, Il. See Alaga

Al-lagat, Il. (A generic term for all Uvarias)
Alluloy, T. See Galó
Almendras, Sp. See Pili
Aloko, I. See Baniti
† ALPAY, T. *Euphoria cinerea* Radlk.
Alubihid, Bu. See Lanno
Alubihon, T. See Lanno
Alupag, T. Applied to Alpay and Kamingi
Alupag-amo, T. See Alpay
Alupak, T. See Alpay
Alúpay, T. Applied to Alpay and Kamingi
Alupi, I. See Dalinsi
Amagá, T., V. See Mabólo
Ambali, Mt. See Kalpi
Amongpong, V. See Kabuyao
Amontay, V. See Kabuyao
Ampal, V. See Banana
Amugis, C. See Lamio
Anagas, V. See Kamiring
Anagas-babak, T. See Manalú
Anangi, B. See Pili
Ananging-puti, T. See Lamio
Anaté. See Annatto
Anibong, V. See Coconut
† ALUAO, Bu. *Euphoria nephelioides* Radlk.
* ANIGLI, E. *Annona senegalensis* Pers.
Anilao. See Barobo
ANNATTO, E. *Bixa orellana* L.
Anonas, Sp.-F. See Custardapple.
Anonóo, See Banana
Ansa, Pa. Applied to Mankil and Manalao
Antipólo, T. See Breadfruit
Antipolong, T. See Breadfruit
† ANTOL, Mt. *Garcinia vidalli Merr.*
Anuáng, T. See Banana
Anúblin, T. See Breadfruit
Apalung, I. See Alpay
Apas, Mt. See Kalpi
APPLE, E. *Pyrus malus* L.
* ARACÁ, E. *Psidium guineense* Sw.
* ARAHIS, E. *Eugenia* sp.
* ARGENA, E. *Eugenia edulis*
Arikúndal, V. See Banana
Arioat, Il. See Ayo
Aropag, T. See Alpay
Arráyan. See Guava
Arupag, V. See Kalayo
Arupay, T. See Alpay
Arusip, Il. See Inyam
Arusit, Mt. See Inyam
Asuti, T. See Annatto
* ATEMOYA, E. *Annona* sp.

Aten. See Pili
Ates, B., T., V. See Sugarapple
† ATIBU, E. *Rubus pectinellus* Max.
Atibulnak, Mt. See Atibu
Atilang, Mt. See Kubili
Atimon, V. See Melon
Atoangan, Mt. See Mankil
Atola. See Annatto
Attit, I. See Sugarapple
Atsuiti, T. See Annatto
Auinguay, Pa. See Kamingi
* AVOCADO, E. *Persea americana* Mill.
Ayagan, Mt. Mandarin
† AYÓ, T. *Tetrastigma harmandii* Planch.
Ayupag. See Alpay
Babak, I. See Yambo
Babana, V. See Guanabano
Badak, C. See Jak
* BAEL, E. *Belou marmelos* Lyons.
Bagabug, P. See Mankil
* BAGEJA, E. *Canarium moluccana* Bl.
Bagó, V. See Banágo
Bagó-Sili. See Banágo
Bahag, Mt. See Lipote
Baimbing, S. See Carambola
Bait, T. See Alpay
Bakalao, Il., Pa., Z. See Alpay
Bakan, T. See Pangao
Bakapie, V. See Kalapi
Balabak, Z. See Lapini
Balabal, Mt. See Mankil
Balabar. See Duhát
Balakbak, T. See Yambo
Balakbat, Il. See Lapini
Balalauan, Bu. See Lanagon
Balasugan, I. See Maigang
Balaungan, Mt. See Palanau
† BALAUSAN, Mt. *Eugenia* sp.
Balayang, Il. See Banana
Balayong, V. See Dao
Balegan, B. See Maigang
Baligang, B. See Lipote
Balik, Za. See Alpay
Balimbin, T. See Carambola
Balimbing, T. See Carambola
Balimbingan, M. See Bulala
Balinaunau, V. See Kalayo
Balingagta, I. See Mabolo
Baliñgbing, B., V. See Carambola
Balinsiagao, Pa. See Bayante
Baliok, Bu. See Kamingi
Balit, V. (a name used for Muling, Kamingi and Alpay)

Balituk, Bu. See Dauag
Balóbar, P. See Yámbo
Balóbo, B., T. See Baróbo
Balokbok, Z. See Lapini
Balokok, Mt. See Binukao
Balono, V. See Bauno
Balonsaging, V. See Alaga
Baloy, T. See Banana
Balsakan, T. See Muling
Balubad, T. See Cashew
Balubag, T. See Cashew
Balubar, T. See Cashew
† BALUBAT, T. *Eugenia claviflora* Roxb.
Balubo, T. See Cashew
Balugug, M. See Barobo
† BALUKO, *Grewia edulis* Merr.
Balukok, T. See Baluko
Baluno, V. See Bauno
† BANÁGO, V. *Gnetum gnemon* L.
Banakin, Mt. See Lingaro
BANANA. *Musa paradisiaca* L.
† BANAUAK, T., V. *Uvaria rufa* Bl.
Bañgal, T. See Banágo
† BAÑGAR, Il. *Sterculia foetida* L.
Bañgkiling, T., V. See Iba
Banilad, T. See Pangao
Banitan, I. See Paho
† BANITI. *Garcinia dulcis* Kurz.
Bankilin, T. See Iba
Bansalágon, T., V. See Kabiki
Banking, S. See Mandarin
* BAOBAB, E. *Adansonia digitata* L.
Barábag. See Yambo.
Barakbak, Il., T. (In Ilocano used for the Adang, in Tagalog for Lapini)
Barit, I. See Uay
Barit, V. See Kalayo
Barongasi. See Inyam
† BAROBO, V. *Diplodiscus paniculatus* Turcz.
Barsik, T. See Kabiki
Barubo, B. See Barobo
Baruntak, L. See Lingaro
Baseng, Il. See Ginger
Basiad, T. See Pili
Basilalag, Mt. See Muling
Bat, I. See Banana
Batang, Bu. See Citron
Batag, B. See Banana
Batikulin. See Dalinsi
† BATUAN, B., V. *Garcinia sulphurea* Elm.
Batukanag, Il. See Bayante
Batulan, T. See Jujube
Baukok, Mt., V., Z. See Binukao

† BAUNO, V. *Mangifera caesia* Jack.
Bayabas, T. See Guava
Bayabas-uak, T. See Dauag
Bayag-usa, T. See Danealan
† BAYANI, T. *Dillenia megalantha* Merr.
† BAYANTE, T. *Aglaia harmsiana* Perk.
Bayauas, B., V. See Guava
Báyet, T. See Alpay
Bayog, V. See Bayante
Bejuco, Sp. (A name employed in the generic sense for all rattans.)
* BERBA, E. *Rheedia edulis* Planch. et Triana.
† BIGNAY, T. *Antidesma bunius* Spreng.
† BIKA, V. *Ampelocissus martini* Planch.
Bilibili, V. See Lamio
Bilimbin, T. See Carambola
Bilat-bilat, S. See Pekola
Bilukao, T. See Binukao (Also applied to the Katuri)
Binalaton, V. See Banana
Binayuyu, Z. See Inyam
† BINUKAO. *Garcinia binucao* Choisy.
* BIRIBA, E. *Rollinia orthopetala* A. DC.
Bisal, T. See Dalinsi
Bisko, T. See Banana
Bislot, T. See Lapini
Bitangol, T. See Rukam
Bitanhol. See Antol
Bitbid B. See Mankil
Bitoag, Bu. See Bignay
Bitoñgon, T. See Bitungol
† BITUNGOL, T. *Flacourtia sepiaria* Roxb.
* BLACKBERRY, E. *Rubus nigrobaccus* Bly.
Boahan, S. See Lanzon
Boboa, V. See Lanzon
Bobog, V. See Bangar
† BOBONAO, V. *Aglaia everetti* Merr.
Bogko, Bu. See Lanzon
Bokok, Mt. See Binukao
Bokpoho, Mt. See Citron
Bolen, Mt. See Antol
Bolik. See Alpay
Bolobolo, Bu. See Karimug
Bolong, T. See Bitungol
Bolonkot, Co. See Pomelo
Bollógo, Il. See Cashew
Bonganlabni, P. See Kalapi
Bonoa. See Lanzon
Bonot, Mt. See Pangao
Bonotán, V. See Coconut
Bookan, V. See Lanzon
Boongon, V. See Pomelo
Botong, V. See Coconut
* BORACHO, Sp. *Lucuma salicifolia* H. B. K.

* BRAZIL NUT, E. *Bertholletia nobilis* Miers.
BREADFRUIT, E. *Artocarpus communis* L.
* BRITOA, E. *Britoa acida* Berg.
Buabua, T. See Mankil
Buáhan, M. See Lanzon
Buán, Co. See Lanzon
Bub-bugnay. See Bignay
Bubua, V. See Bobonao
Bugatot, V. See Antol
Buglay, Mt. See Bignay
Bugnai, B., V. See Bignay
Bukad, M. See Barobo
Bukalao, I. See Alpay
Bulahan, V. See Lanzon
† BULALA, B., T. *Nephelium mutabile* Bl.
Buli, M. See Bulala
Bulibuli, V. See Kalayo
Bulog, V. See Bobonao
† BULSO, Bu. *Gnetum indicum* L.
Buluang, V. See Dalinsi
Bulubi. See Barobo
† BUNAG. *Garcinia benthami* Perr.
Buneg, Il. (A name used for both Baniti and Katuri)
Buneg, Ib. See Malabu
Bunguas, V. See Bobonao
Bunlauan, V. See Yambo
Bunnék, Il. See Banana
Bunot-bao, Il. See Tibao
Bunug, Pa. See Antol
† Buol, D. *Ximenia americana* L.
Bunutan, I. See Paho
* BUNYA, E. *Araucaria bidwilli* Hook.
Buragris, B. See Binukao
Burauis. See Dalinsi
Buru, M. See Barobo
* BURUNG, E. *Baccaurea dulcis* Muell. Arg.
Butnéng, Il. See Banana
Buyog, T. See Kabuyao
Buyon, Mt. See Antol
CACAO, Sp. *Theobroma cacao* L.
Café, Sp. See Coffee
* CAIMITILLO, Sp. *Chrysophyllum oliviforme* Lam.
* CAIMITO, Sp. *Chrysophyllum cainito* L.
* CANISTEL, Sp. *Lucuma nervosa* A. DC.
CARAMBOLA, E. *Averrhoa carambola* L.
* CARDAMON, E. *Amomum cardamomum* L.
CAROB, E. *Ceratonia siliqua* L.
CASHEW, E. *Anacardium occidentale* L.
* CATTLEY, E. *Psidium cattleianum* Sabine
* CEFALUS, E. *Sarcocephalus esculentus* Afzel.
* CERIMAN, E. *Monstera deliciosa* Liebm.
* CHANÁR, Sp. *Gourliea decorticans* Gs.
* CHERIMOYA, E. *Annona cherimolia* Mill.

* CHESANG, E. *Cudrania tricuspidata* Bu.
CHESTNUT, E. *Castanea sativa* Mill.
CHICO, Sp.-F. *Achras zapota* L.
CHICO-MAMEY, Sp.-F. *Achradelpha mammosa* O. F. C.
Chuaguy, Mt. See Duguay
Cidra, Sp. See Citron. (Sometimes also employed to designate the Dalayap)
Ciniguelas, B., T., V. See Ciruela
CINNAMON, E. *Cinnamomum zeylanicum* Nees.
CIRUELA, Sp. *Spondias purpurea* L.
CITRON, E. *Citrus medica* L.
Coco, Sp. See Coconut
COCONUT, E. *Cocos nucifera* L.
* COFFEE-ABEOTA, E. *Coffea abeocuta* Cramer
COFFEE-ARABIAN, E. *Coffea arabica* L.
* COFFEE-CANEFORA, E. *Coffea canephora* Pierre
* COFFEE-CONGO, E. *Coffea congensis* Froehn.
* COFFEE-EXCELSA, E. *Coffea excelsa* Chev.
COFFEE-LIBERIAN, E. *Coffea liberica* Hiern.
* COFFEE-QUILLOU, E. *Coffea quillou.*
* COFFEE-ROBUSTA, E. *Coffea robusta* L. Linden.
* COFFEE-UGANDA, E. *Coffea ugandae.*
† COPELA, E. *Rubus copelandi* Merr.
* CORICA, E. *Coccoloba* sp.
* COROZO, Sp. *Acrocomia sclerocarpa* Mart.
* COS, E. *Psidium friedrichsthalianum* Ndz.
CUSTARDAPPLE, E. *Annona reticulata* L.
* CYNDRA, E. *Cyphomandra calycina* Sendt.
Dagingdingan, V. See Alpay
Daiamiras, T. See Bayante
Dakad, Mt. See Pineapple
Dalandán, T. See Orange
† DALAYAP, Mt. *Citrus aurantifolia* var *aromatica* Wester
Daligan, Il. See Carambola
Dalima, M. See Pomegranate
Dalimdiman, Bu. See Bignay
† DALINSI, T. *Terminalia edulis* Blanco
Dambuhala, T. See Mankil
* DAMIA, E. *Macadamia ternifolia* Muell.
Damortis, Il. See Kamanchile
Dampol, V. See Inyam.
† DANEALAN, B. *Garcinia subelliptica* Merr.
† DAO, I., B., C., B. *Dracontomelum dao* M. & R.
Darakan, Il. See Alakao
DATE, E. *Phoenix dactylifera* L.
† DAUAG, T. *Capparis micracantha* DC.
Dayap, T. See Lime. (A name sometimes applied also the Limoncito)
Deguay, Mt. See Duguay
Demopa, I. See Alpay
DENDÉ, *Elaeis guineensis* Jacq.
* DERMA, E. *Annona scleroderma* Saf.
Dingin, Z. See Katmon

Dinuguan, T. See Banana
Dirig-kalin, B. See Dalinsi
Disit, I. See Dalinsi
Dokog. See Rukam
Dokoroko, Bu. See Bayante
Dúat, P., T., V. See Dúhat
† DUGUAY, Mt. *Saurauia bontocensis* Merr.
DUHAT, P., T., V. *Syzygium cumingi* Skeels.
* DUKU, E. *Lansium domesticum* Jack. var. *duku.*
Dulian, M. See Durián
Dulugot, S. See Kalpi
DURIAN, E. *Durio zibethinus* L.
Estiuitis, V. See Annatto
Falo-ok, Mt. See Pomelo
* FEIJOA, E. *Feijoa sellowiana* Berg.
FIG, E. *Ficus carica* L.
Folen, Mt. See Antol
Gadia, S. See Pomelo
Galanada, Bu. See Pomelo
Galangan, V. See Carambola
Galangita, Bu. See Orange
† GALO, T. *Anacolosa luzoniensis* Merr.
Galuran. See Carambola
* GANDARIA, E. *Bouea macrophylla* Griff.
Garanada, L. See Pomelo
Garangan, V. See Carambola
Gatasan, T., V. (In Tagalo applied to Katuri, in Visayo to Baniti)
Gauid, Mt. See Guyod
Gayaba, Mt. See Pomelo
Gayaet, Mt. See Guava
Gayumahin, Z. See Dalinsi
Gayunan, Mt. See Pomelo
* GENIPA, E. *Genipa americana* L.
Gimma, Mt. (In certain districts of the Mountain Province applied in the generic sense to all citrus fruits.)
GINGER, E. *Zinziber officinale* Rosc.
Ginia, Bu. See Pineapple
Gisit, I. See Dalinsi
Givagava, Z. See Coconut
Gogolat, Mt. See Kinubo
Golod, Mt. See Kalpi
† GOMIHAN, B. *Artocarpus elastica* Reinw.
Gonod, Mt. See Kalpi
Goyabano, Sp.-F. See Guanábano
Goyóran, T. See Banana
Granada, Sp. See Pomegranate
GRANADILLA, E. *Passiflora quadrangularis* L.
* GRAPE-MUSCADINE, E. *Vitis rotundifolia* Michx.
GRAPE-VINIFERA, E. *Vitis vinifera* L.
Grapefruit, E. See Pomelo.
* GRUMICHAMA, E. *Eugenia dombeyi* Skeels.
GUANÁBANO, Sp. *Annona muricata* L.

GUAVA, E. *Psidium guajava* L.
Guayába, Sp. See Guava
Guin-guin, T. See Longan
* GUISARO, Sp. *Psidium molle* Bertol.
Guisihan, T. See Alpay
Guisok. See Barobo
Gulod, Mt. See Kalpi
Gumihan, B. See Gomíhan
Guyába, Sp. See Guava
Guyabano, T. See Guanábano
† GUYOD, Mt. *Citrus webberii* var. *montana* Wester.
Habana. See Guanábano
Habas, V. See Dao
Hagasan, V. See Bayante
Hagumunan, B. See Tamil
Halubagat, T. See Dauag
Halupag, T. See Alpay
Hamo, B. See Tersana
Hangos. See Tulana
Hantak, I. See Pangao
* HEVI, E. *Spondias cytherea* Sonn.
*(?) HONDAPARA, E. *Dillenia indica* L.
Huampit. See Wampi
† HUANI, M. *Mangifera odorata* Griff.
Huanita, M. See Huani
Huckleberry, E. (See Alemani and Kotmo)
Hungo, T. See Konnakon
Huyo, B. (Used in a generic sense for all rattans)
IBA, B., T., V. *Phyllanthus acidus* Skeels.
Ibule, T. See Kubili.
* ICACO, E. *Chrysobalanus icaco* L.
Iddulu. See Kamia
† IGANG, L. *Eugenia garciae* Merr.
Igos, Sp. See Fig.
Igot, V. See Lipoti
* ILAMA, E. *Annona diversifolia* Saf.
Illuru, Ib. See Kamia
* IMBU, E. *Spondias tuberosa* Arr.
Inapugan, L. See Kalpi
Iniw, Z. See Banauak
† INOGUG, C. *Eugenia* sp.
† INYAM, T., V. *Antidesma ghaesembilla* Gaert.
Isip, P. See Bignay
Ituman, V. See Mabolo
Iva, V. See Kamia
JAK, E. *Artocarpus integra* L.
JUJUBE, E. *Ziziphus jujuba* L.
† KABANGLA, Bu. *Garcinia* sp.
† KABIKI, B. *Mimusops elengi* L.
Kabugao, Mt. See Guyod
† KABUYAO, Pa., T. *Citrus hystrix* DC.
Kaddog, Mt. See Binúkao

Kagaykay, Bu. See Pangao
Kagel, Sp.-F. See Orange
Kagsakan, B. See Kamingi
Kaguku, M. See Mankil
Kahána, M. See Coffee
Kahél, B., T., V. See Orange
Kahoko, V. See Mankil
Kakel, Mt. See Mandarin
KAKI, E. *Diospyros kaki* L.
Kalamansali, T. See Dalinsi
Kalamansanoy, Z. See Rukam
Kalamansé, T. See Kalamondin
Kalamasali, Z. See Rukam
Kalamías, T. See Kamia
† KALAMONDIN, T. *Citrus mitis* Blanco
Kalaotit, I. See Dalinsi
† KALÁPI, T. *Calamus ornatus* var. *Philippinensis* Becc.
† KALAYO, T. *Erioglossum edule* Bl.
Kalinbagín, T. See Guava
Kalingag, L. See Kulia
Kalit-kalit, T. See Ayo
Kalmay, See Iba
Kalmuyas, T. See Kamia
Kálo, See Gomíhan
Kalobkob. See Adang
Kalingiwa, V. See Kamia
Kalomahi, Mt. See Tamarind
Kalompán, T. See Bangár
Kalómpit, T. See Dalinsi
Kalo-oy, V. See Kabuyao
Kalotib, Mt. See Alemani
Kalsaang, Mt. See Pomelo. (A name also used for a fruit-bearing, unidentified species of Eugenia in the Mountain Province)
Kalumagon. See Dalinsi
† KALPI, B. *Citrus webberi* Wester.
Kalubkub, T. See Adang
Kalugkog. See Adang
Kalumagon, B. See Dalinsi
Kalumánog, V. See Dalinsi
Kalum-nga, Il. See Rukam
Kalúmpag, T. See Bangar
Kalumpang, T. See Bangar.
Kalumpit, T. See Dalinsi
Kalumpit-na-puti, T. See Muling
Kalungpang, T. See Bangár.
Kalupay, Z. See Alpay
Kalupi, I. See Dalinsi
Kalumagon. See Dalinsi
Kalurig, I. See Dalinsi
Kalusit, I. See Dalinsi
Kamagón, B., T., See Mabólo
Kamagsa, T. See Lingaro

Kamagúan. See Mabólo
Kamalági, V. See Tamarind
Kamalitos, T. See Limoncito
KAMANCHILE, T. *Pithecolobium dulce* Benth.
Kamandies, See Kamani
Kamangsi, T. See Binukao
* KAMÁNI. *Garcinia rubra* Merr.
Kamanitiis, B. See Kamani
Kamansíle, B., T., See Kamanchíle
Kamantaris, Il. See Kamanchíle
Kamaris. See Dalinsi
Kamastéles, V. See Kamanchíle
Kamasi, C. See Breadfruit
Kambias-kambias, Za. See Pepi
Kambog, M. See Palali
* KAMI, L. *Cinnamomum mindanaense* Elm.
KAMIA. *Averrhoa bilimbi* L.
Kamias, T. See Kamia
Kamilíng. See Baróbo
Kaming, P. See Kamiring
† KAMINGI, T. *Litchi philippinensis* Radlk.
† KAMIRING, Il. *Semecarpus cuneiformis* Blanco
Kamisan, V. See Tamisan
Kamochíle. See Kamanchíle
Kamoning, T. See Limoncito
Kamonsil, V. See Kamanchíle
Kamuling, T. See Muling
Kamuyao, I. See Kabuyao
* KANARI, E. *Canarium commune* L.
* KANSI, V. *Citrus hystrix* var. *boholensis* Wester.
Kandiat, Mt. See Bulso
Kandiis, M. See Kamani
Kandis, T. See Binukao
Kandongisol, B. See Alpay
Kandopi, S. See Huani
Kanining pute, T. See Koraiap
Kantol, Mt. See Santol
Kanumay, Il. See Binukao
Kanyan, D. See Inyam
Kapáyas, T., V. See Papaya
Kapitan, I. See Mandarin
Karaktón, V. See Banana
Karameras, T. See Koraiap
* KARANDA, E. *Carissa carandas* L.
† KARIIS, Bu. *Garcinia lateriflora* Bl.
† KARIMUG, L. *Saurauia reticulata* Merr.
Karmay, T. See Iba
Karnáte, V. See Banana
Karobkob. See Adang
Karogkog, B. See Yambo
Karumamis, L. See Orange
Kasóy, B., T., V. See Cashew

Kastañas, T. See Galó
Kasuit, P. See Dauag
Katapang. See Antol
† KATMON, B., T., V. *Dillenia philippinensis* Rolfe
Katmon carabao, T. See Palali
Katolit, Mt. See Baniti
† KATÚRI, I. *Garcinia venulosa* Choisy.
Kaumpáng, M. See Bangár
Kayakuat, Mt. See Guava
KAYAM, V. *Inocarpus edulis* Forst.
Kayogpug. See Adang
Kayokok, B. See Lapini
* KECHAPI, E. *Sandoricum radiatum* King.
* KETEMBILLA, E. *Aberia gardneri* Clos.
Kiama, C. See Kayam
Kilingiva, V. See Kamia
Kingingi, Mt. See Kalpi
† KINUBO, Mt. *Rubus moluccanus* L.
Kinubot, Mt. See Kinubo
* KLEDANG, E. *Artocarpus lancaefolia* Roxb.
Kolkolnog, Mt. See Pangao
Kollogo, Il. See Cashew
Kólo, V. See Gomihan
Kolonáuas, T. See Kamia
Komantiris, V. See Kamanchíle
† KONNÁKON, Mt. *Eleocarpus calomala* Merr.
Kopahan, V. See Kabuyao
Kopen, Mt. See Orange
Kopyao, Mt. See Tersana
† KORAIAP. *Aglaia glomerata* Merr.
Koriguelas, V. See Ciruela
† KOTMO, Mt. *Vaccinium whitfordii* Merr.
Kotmók, B. See Dalinsi
† KUBILI, T. *Cubilia blancoi* Bl.
* KUCHING, E. *Nephelium malaiense* Griff.
† KULIA. *Cinnamomum culilawan* Bl.
Kuliát, T. V. See Bulso
Kuluris. See Alpay
Kumbug, M. See Katmon
* KUMQUAT, E. *Fortunella japonica* Swg.
Kupkup. See Adang
Laba, S. See Mango
Labanos, S. See Guanabano
Labnit, B. See Kalápi
Laginata, M. See Palanau
Lagiauat, L. See Ragini and Palanau
Lagilay, L. See Citron
Lagot, Bu. See Lingaró.
Laioan, B. See Iba
Lakangan, Il. See Tulana
Lakalan, Za. *Citrus* sp.
† LAMIO, I. *Dracontomelum edule* Skeels.

* LAMUTA, *Cynometra cauliflora* L.
† LANAGON, Bu. *Flacourtia sulcata* Elm.
Lanka, T. See Jak.
Langka, B., Il., V. See Jak.
† LANNO, I. *Spondias pinnata* Kurz.
Lanu, I. See Lanno
Lanutan, T. See Mabolo
LANZON, Sp.-F. *Lansium domesticum* Jack.
† LAPÍNI, E. *Eugenia xanthophylla* C. B. R.
Lapinig, B. See Lapini
Lapitus, C. See Carambola
Lapnisan, V. See Muling
Lapote, T. See Maigang
* LAURIVA, E. *Psidium laurifolium* Berg.
Layál, Z. See Ginger
Layóhan, V. See Iba
* LEMÁSA, E. *Artocarpus polyphoema* Pers.
LEMON, E. *Citrus limonia* Osb.
Libas, B., M., T. See Lanno. (In some parts of Mindanao also applied to Antol.)
Ligas, T. (Applied both to Kamiring and Manalú)
Ligayan, M. See Kabiki
LILIKOI, E. *Passiflora edulis* Sims.
LIME, E. *Citrus aurantifolia* Swg.
Limon, Sp., T. (More specifically applied to the lemon and *Citrus medica* var. *nanus* Wester, but also employed to designate other acid citrus fruits, such as the lime, dalayap, citron, kalpi, *Citrus excelsa* and its variety *davaoensis*)
Limonáto. See Limoncito
LIMONCITO. *Triphasia trifolia* P. Wils.
Limoncitos, B. See Limoncito
LIMON-REAL, Sp. *Citrus excelsa* Wester
Limuran, T. See Kalapi
Limyang, T. See Inyam.
† LINGARO, T. *Eleagnus philippense* Perr.
Linsap, Bu. See Manalao
† LIPÓTI, T. *Eugenia curranii* C. B. R.
LITCHI, E. *Litchi chinensis* Sonn.
† LITOKO, Mt. *Calamus* sp.
Litu-u, I. See Litoko
Lolokisen, Il. See Mandarin
* LONEFO, E. *Buchanania latifolia* Roxb.
LONGAN, E. *Euphoria longana* Lam.
* LOQUAT, E. *Eriobotrya japonica* Lindl.
* LOUVI, E. *Flacourtia inermis* Roxb.
Lubas, B. See Lanno
Lubí, V. See Coconut
Lubilubi, T. See Kubili
Lukban, T. See Pomelo
Lumbói, Il., T., V. See Dúhat
Lumbonao, V. See Bobonao.
Lupak., B. See Alpay

Lupal, C. See Alpay
Lupigin, I. See Dao.
Lurad, I. See Kalpi
Luting, Mt. See Palanau
Lúya, B., T., V. See Ginger
Luya-pagirisan, L. See Ginger
Maal, C. See Buol.
† MABÓLO, T. *Diospyros discolor* Willd.
Madang, L. See Marang
* MADRONO. *Rheedia madrono* Planch. et Triana
Magiono, V. See Tulana
Magtalisay, B., V. See Dalinsi
Maigang, D. See Igang
† MAIGANG, V. *Eugenia polycephaloides* C. B. R.
Makaasim, T. See Mankil
Makao, C. See Dao.
Makasampálok, T., V. See Tamarind
Malabilukao, T. See Pildis
† MALÁBU. *Garcinia cumingiana* Pierre.
Malabunok, I. See Malabu
Malacacao, T. See Kalayo
Mala-dayap, T. See Mamata
Malahaguis, B. See Mankil
Malaigot, V. See Bulso
Malaimus, V. See Lingaro
Mala-kanasi, B. See Mamata
Malakupa, V. See Adang
Malapaho, Za. See Paho
Malarayap, T. See Manalao
Malaruhat, Z. See Mankil
Malasángi. See Cinnamon
Malasantol, V. See Bobonao
Malatampoy, V. See Lapini
Malatápay, T. See Mabolo
Malatbas, Za. See Kabuyao
Malatumbaga, T. See Bayante
Malibusug, Za. See Kalayo
Malinbin, V. See Carambola
Malisa, B., T. (A name applied to the pineapple in Bicol and to pepper in Tagalo)
Malono. See Bauno
* MALPI, E. *Malpighia glabra* L.
Malúbo, T., V. See Baróbo
Malugay, T. See Dao.
† MAMÁTA, E. *Lansium dubium* Merr.
Mamakau, C., D. See Dao
Mamata-babas, V. See Mamata
* MAMEY, E. *Mammea americana* L.
Mamikahan. See Barobo
Mamis, S. See Mandarin
* MAMÓN, Sp. *Annona glabra* L.
* MAMONCILLO, Sp. *Melicocca bijuga* L.

Mampálan, M. See Mango.
Mamonak, Za. See Bayante
† MANALAO, T. *Aglaia bordeni* Merr.
† MANALU, V. *Semecarpus gigantifolia* F. Vill.
Manáyao. See Baróbo
MANDARIN, E. *Citrus nobilis* Lour.
* MANDALIKA, E. *Artocarpus rigida* Bl.
Manga, T., V. See Mango
Mangabu, M. See Barobo
Mangala, M. See Katuri
Mangalukban, Pa. See Manalao
Mangapug, C. See Kalpi
Manggá, B., T., V. See Mango
Mangkopa, V. See Tersana
MANGO, E. *Mangifera indica* L.
MANGOSTEEN, E. *Garcinia mangostana* L.
Manguis, M. See Mangosteen
Mangustan. Sp. See Mangosteen
Maninila, B. See Binukao
† MANKIL. *Eugenia mananquil* Blanco
Mantilit, I. See Kamanchile
Manzana, Sp. See Apple. (Also applied to the jujube)
Manzána-rosa, Sp. See Yambo
Manzanitas, Sp.-F. See Jujube
Maobo, V. See Barobo
Maraman, Il. See Barobo
† MARANG, S. *Artocarpus odoratissima* Blanco
Marangis, Mt. See Bulala
Marautong, I. See Alpay
* MARÓN, E. *Annona montana* Macf.
Marubo, B. See Barobo
* MASTIC, E. *Sideroxylon mastichodendron* Jacq.
Mata-mata, B., Za. (Applied to Alpay in Za. and to the Bayante in B.)
Matangutang, T. See Bayante
* MATASANO, Sp. *Casimiroa edulis* LaLl.
Matobato, V. See Galó
* MATÉ, Sp. *Ilex paraguariensis* St. Hil.
† MIARAY, Bu. *Citrus miaray* Wester
Midbid, T. See Mankil
Minul, C. See Inyam
* MIRIM, Sp. *Rollinia emarginata* Schlecht. (?)
* MISTOL, *Ziziphus mistol* Griseb.
* MITNAI, E. *Artocarpus* sp.
* MOMBIN, E. *Spondias lutea* L.
Moras, Sp. F. See Mulberry
Moyong, Mt. See Pomelo. (A name also applied to a species of a fruit-bearing *Eugenia* in the Mountain Province)
MULBERRY, E. *Morus alba* L.
† MULING, T. *Grewia stylocarpa* Warb.
Mulíng-mulíng, T. See Baróbo
Munkinkil, T. See Mankil
Muntay, C. See Kabuyao

Muntay-muntay, S. See Lemoncito.
MUSKMELON, E. *Cucumis melo* L.
* MYRCIA. *Myrciaria floribunda* Berg.
Namot, Il. See Muling.
Nanas, C. See Pineapple
* NANCE, E. *Byrsonima crassifolia* H. B. K.
Nanka, T. See Jak.
Naranjitas, B., T., V. See Mandarin
Naránja, Sp. See Orange. (In some provinces applied to the Pomelo.)
* NELLI, E. *Phyllanthus emblica* L.
Ngongot, P. See Coconut
Nignul, C. See Inyam
Ninur, C. See Inyam
Niog, B., I., Il., T., V. See Coconut
Niog-niogan, T. See Manalú
* NORTHEYBERRY, E. *Rubus betulaefolius* Small.
Obieng, Il. See Rukam
Ogób, B. See Gomíhan
Óloy, T. See Marang
Ongot, Z. See Coconut
ORANGE, E. *Citrus sinensis* Osb.
Ovas. See Grape.
Pa-a, I. See Breadfruit
Pabangi. See Antol
Paga, Mt. See Palanau
Paga, L. See Pomelo
Pagpagan, Il. See Kabiki
Paginga, Ib. See Bignay
† PAHO, T., V. *Mangifera altissima* Blanco
Paakak, Ib., Il. See Breadfruit
Padias, Mt. See Lingaro
Pahuhutan, T. See Paho
Pahutan, T. See Paho. (There is also a variety of the mango under this name which is quite distinct from the Paho)
Pakankal, P. See Alakáo
Pálakpálak, T. See Alakáo
Palalakanin, T. See Kalapi
† PALALI, B., Ib., Il., Mt. *Dillenia riefferscheidia* F. Vill.
† PALANAU, Mt. *Rubus fraxinifolius* Poir.
Palatangan, Il. See Bayante
Pali, V. See Huani
Palutan, I. See Bitungol
Pamanmalien, Pa. See Katmon
Pamokol, T. See Coconut
Pamontulon, Bu. See Dalayap
Pampáng, V. See Banana
Pangahutan, T. See Paho
† PANGAO, Mt. *Sterculia oblongata* R. Br.
Pángas, Z. See Ginger
† PANGI, T., V. *Pangium edule* Reinw.
Pangmangaen, Il. See Paho
Panglongbuyen-kopaioba, Il. See Mankil

Panglumbuyan, Il. See Adang
Pangungan, See Buol.
* PANIALA, E. *Flacourtia cataphracta* Roxb.
Panuto, V. See Alpay
Papagan, Il. See Kabiki
PAPAYA, E. *Carica papaya* L.
Papling, T. See Muling
Parasán, V. See Kalapi
* PARCHA, Sp. *Passiflora laurifolia* L.
Parusit, Mt. See Inyam
Pasák, T., Z. See Kabiki
Pasoso, T. See Mankil
Patlong, Z. See Muling
PEACH, E. *Prunus persica* Sieb. et. Zucc.
Pelipeli, B. See Bayante
PEKOLA, E. *Mimusops kauki* L.
† PEPI, V. *Garcinia pinnatinervia* Elm.
PEPPER, E. *Piper nigrum* L.
* PERESKIA, E. *Pereskia aculeata* Mill.
Peris, T. See Antol.
* PERUNKILA, E. *Carissa* sp.
* PHALSA, E. *Grewia asiatica* L.
Pias, Il., T. See Kamia
Piat, I. See Carambola
Pikso, Mt. See Citron
Pilaui, T. See Pili
† PILAY, Mt. *Rubus niveus* Thunb.
† PILDIS, P. *Garcinia dives* Pierre.
† PILI, B., T., V. *Canarium ovatum* Engl.
Pili-pili, B. See Bayante
Pimienta, Sp. See Pepper
PINEAPPLE, E. *Ananas sativus* Schult.
Piña, Sp. See Pineapple
* PINHO, Sp. *Rollinia* sp.
Pinit, Il. (A name used in the generic sense for all species of *Rubus*.)
Piras, V. See Iba
Pisang, S. See Pineapple
Pisas, Il. See Kamia
Pison, T. See Tizon
* PITANGA, E. *Eugenia uniflora* L.
Plátano, Sp. See Banana
* POHA, E. *Physalis peruviana* L.
Pohpoho, Mt. See Citron
Polon, Mt. See Antol
POMEGRANATE, E. *Punica granatum* L.
POMELO, E. *Citrus maxima* Merr.
* PÓNHE. *Annona marcgravii* Mart.
Popowan. See Paho
Póras, V. See Iba
Poren, Mt. See Antol
Potian, T. See Manalao
Potot, V. See Coconut

Pulapula, M. See Banana
Puled, I. See Muling
Pupugan, Mt. See Palanau
† RAGÍNI, B. *Rubus rosaefolius* Sm.
* RÁMBI, E. *Baccaurea motleyana* Muell. Arg.
RAMBUTAN, E. *Nephelium lappaceum* L.
Rattan, edible. See Bejuco
Remuran, B. See Kalapi
Rima, T. See Breadfruit
† ROLFÈIA, E. *Rubus rolfei* Vid.
* ROSELLE, E. *Hibiscus sabdariffa* L.
† RUKAM, E. *Flacourtia rukam* Zoll. et M.
Rukrueso, I. See Tulana•
Saba-ti-kaag, Mt. See Banauak
Sagakat, Mt. See Jak
Ságing, T., V. See Banana
Saigoot, S. See Dauag
Sakat, T. See Dalinsi
Salabagin, V. See Rukam.
* SALAK, E. *Zalacca edulis* Reinw.
Salamungay, T. See Bayante
Salikaya, S., C. See Custardappale
Sal-lapugud, Il. See Bayante
Salomáge, Il. See Tamarind
Saloua-sua. V. See Dauag
Samalági, V. See Tamarind
Sambági. V. See Tamarind
Sambák, B. See Tamarind
Sambalági, V. See Tamarind
Sambalduge, Il. See Cashew
Sambonalan. See Tulana
Samilin, T. See Cinnamon
Samlagi, V. See Tamarind
Sampalági, B. See Tamarind
Sampalok, B., P., T. See Tamarind
Sampinit, V. (Employed generically for all species of the genus *Rubus*)
Sanbag, V. See Tamarind
SANDIA, Sp. *Citrullus vulgaris* Schrad.
Sanpongpong, B. See Pangao
* SANSAPOTE, Sp. *Licania platypus* Fritsch.
Santias, T. See Bulala
† SANTOL, B., P., T., V. *Sandoricum koetjape* Merr.
Santor, Z. See Santol
Sapingit, L. See Kinubo
Sapinit, T. (Used in the generic sense for all species of *Rubus*)
Saplungan, Za. See Bayante
Sapote. See Zapote
Sáua-sáua, V. Bitungol
* SERALI, E. *Flacourtia ramontchi* l'Herit.
Siko, V. See Chico
Sindók, T. See Cinnamon
Sintones, T. See Mandarin

Sirihúelas, T. See Ciruela
* SONCOYA, Sp. *Annona purpurea* Moc. et Sessé.
Sosong dalaga, Z. See Muling
SOUR ORANGE, E. *Citrus aurantium* L.
* STRAWBERRY, E. *Fragraria chiloensis* Duch.
SUGARAPPLE, E. *Annona squamosa* L.
Suha or Sua, Il., T., V. (Applied in a generic sense to all the Citrus fruits in some provinces, in others applied specifically to the Orange or Pomelo)
Suha-suha, S. See Lemoncito
Sumalági, V. See Tamarind
† SUSONG-BABAY, Bu. *Citrus excelsa* var. *davaoensis* Wester.
Súsong-calabao, T.,V. (A name used in the generic sense for all species of *Uvaria*)
Susu-abay, L. See Citron
Susubik, T. See Muling
Susumbig, T. See Muling
Suya, V. See Coconut
* SYKAMORE, E. *Ficus sycomorus* L.
Tabagok, V. See Muskmelon
Tábang, T. See Mabolo
Tabas, V. See Kubili
Tabbayog, Mt. See Pomelo
† TABÚ. *Sterculiaceae.*
Tadiang-kalabau, T. See Bayante
† TAGKON, V. *Garcinia samarensis* Merr.
Tagpam. See Barobo
Tagurirong, V. See Kalayo
Taklang anak, T. (A name applied both to the Baniti and Katuri.)
Talama, Mt. See Kabuyao
Talalang, I. See Kubili
Talamisan, V. See Tamisan
Talihoho, V. See Kabiki
Talimurun, T. See Kalapi
Talipopo, V. See Kabiki
Talutalu, M. See Barobo
Tamanyan, V. See Mamata
TAMARIND, E. *Tamarindus indica* L.
Tamarindo, Sp. See Tamarind
† TAMBIS, M. *Eugenia aquea* Burm.
Tambuyog, Mt. See Pomelo
Tam-is, V. See Coconut
Tam-isán, V. See Coconut
† TAMIL, Bu. *Garcinia tetrandra* Pierre
† TAMISAN, V. *Citrus longispina* Wester.
Tampái. See Dúhat
Tampói, T., V. See Yambo
Tangal, B. See Dalinsi
Tangiling-bangohan, T. See Bayante
Tanpul, I. See Yambo
Tapalong, Mt. See Mankil

Tapaya. See Papaya
Tarabtab, Il. See Dauag
Tarnáte, V. See Banana
Tatlang-anak, T. See Baniti
Tayabas, T. See Guava
Tayataya, V. See Dalinsi
TEA, E. *Thea sinensis* L.
† TEBDAS, Il. *Calamus mitis* Becc.
Tengé, Mt. See Alemani
TERSANA. *Eugenia malaccensis* L.
† TIBAO, Il. *Rubus elmeri* Focke.
Tibungao, Ib. See Bayante
Tila, B. See Binukao
Tilig, Mt. See Alpay
Tinikan, T. See Dauag
Tinálong, T. See Banana
Tipolo, M. See Breadfruit
† TITAO, Il. *Rubus ellipticus* Sm.
TIZON, Sp. *Citrus nobilis* var. *papillaris* Blanco
Toangang, Mt. See Adang
Tokud-langit, T. See Manalú
Topo, B. See Manalú
* TRYNO, E. *Strychnos spinosa* Lam.
Tsiku, T. See Chico
Tual, C. See Tersana
Tubal, Bu. See Tersana
Tugao-tugao, V. See Palanau
Tugatoy, T. See Kabiki
Tugup, V. See Gomihan
† TULANA. *Eugenia aherniana* C. B. R.
Tulanan, V. See Tulana
* TÚNGULU, E. *Carissa grandiflora* DC.
Tuoy, T. See Adang
Uámpit. See Wampi
† UAY, B., T., V. *Calamus mollis* Blanco
Uban-uban, B. See Mamata
Ulandug. See Lamio.
† ULAYA, V. *Castanopsis philippensis* Vid.
Ulayan, V. See Ulaya
Uloy, T. See Marang
* UMKOLO, E. *Aberia caffra* Hook. et Harv.
Ungo, T. See Konnakon
Uos, B. See Pangao
Usao, S. See Rambutan
* UVERO, Sp. *Coccoloba uvifera* L.
Uyat, Za. See Banana
* VANILLA, E. *Vanilla planifolia* Ans.
* VILATTI, E. *Feronia limonia* Swg.
* VOAVANGA, E. *Vangueria madagascariensis* J. F. Gmel.
WAMPI, E. *Claucena lansium* Skeels
Wannih, S. See Huani.
Watermelon, E. See Sandia

Yalnang, Bu. See Annatto
YAMBO, T. *Caryophyllus jambos* Stokes
Yambolin. See Yámbo
Yambósa. See Yámbo
Yantok, T., or Yantog. (A name used in the generic sense for all rattans. See Kalapi, Litoko, Tebdas and Uay)
Yantog na puti. Z. See Uay
* YARÚMA, E. *Cecropia palmata* Willd.
Yba, T. See Iba
Yuppa, I. See Galó
ZAPOTE, Sp. *Diospyros ebenaster* Retz.

INDEX BY SPECIES

Aberia caffra Hook. f. et Harv. UMKOLO
——*gardneri* Clos. KETEMBILLA
Achradelpha mammosa O. F. C. CHICO-MAMEY
Achras zapota L. CHICO
Acrocomia sclerocarpa Mart. COROZO
Adansonia digitata L. BAOBAB
Aglaia bordenii Merr. MAÑALÁO
——*everettii* Merr. BOBONÁO
——*glomerata* Merr. KORAIAP
——*harmsiana* Perk. BAYANTE
Amomum cardamomum L. CARDAMON
Ampelocissus martini Planch. BIKA
Anacardium occidentale L. CASHEW
Anacolosa luzoniensis Merr. GALO
Annona cherimolia Mill. CHERIMOYA
——*diversifolia* Saf. ILAMA
——*glabra* L. MAMON
——*marcgravii* Mart. PONHE
——*montana* Macf. MARON
——*muricata* L. GUANÁBANO
——*purpurea* Moc. et Sesse. SONCOYA
——*reticulata* L. CUSTARDAPPLE
——*scleroderma* Saf. DERMA
——*senegalensis* Pers. ANIGLI
——sp. (hybrid, cherimoya X sugar-apple.) ATEMOYA
——*squamosa* L. SUGAR-APPLE
Antidesma bunius Spreng. BIGNAY
——*ghaesembilla* Gaert. INYAM
Araucaria bidwilli Hook. BUNYA
Artocarpus communis L. BREADFRUIT
——*elastica* Reinw. GOMIHAN
——*integra* L. JAK
——*lancæfolia* Roxb. KLEDANG
——*odoratissima Blanco.* MARANG
——*polyphœma* Pers. LEMASA
——*rigida* Bl. MANDALIKA
——sp. MITNAI
Averrhoa bilimbi L. KAMIA
——*carambola* L. CARAMBOLA
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Britoa acida Berg. BRITOA
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Byrsonima crassifolia H. B. K. NANCE
Calamus mitis Becc. TEBDAS
——*mollis* Blanco. UAY
——*ornatus* var. *philippinensis* Becc. KALÁPI
——sp. LITOKO
Canarium commune L. KANARI
——*moluccana* Bl. BAGEJA
——*ovatum* Engl. PILI
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Carica papaya L. PAPAYA
Caryophyllus jambos Stokes. YAMBO
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——*carandas* L. KARANDA
——sp. PERUNKILA
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Castanea sativa Mill. CHESTNUT
Castanopsis philippensis Vid. ULÁYA
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Ceratonia siliqua L. CAROB
Chrysophyllum cainito L. CAIMITO
——*oliviforme* Lam. CAIMITILLO
Chrysobalanus icaco L. ICACO
Cinnamomum culilawan Bl. KULIA
——*mindanænse* Elm. KAMI
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—— ——*aromatica* West. DALAYAP
——*aurantium* L. SOUR ORANGE
——*excelsa* West. LIMON-REAL
—— ——var. *davaoensis* West. SUSONG-BABAY
——*hystrix* DC. KABUYAO.
——*hystrix* var. *boholensis* West. KANSI
——*limonia* Osb. LEMON
——*longispina* West. TAMISAN
——*maxima* Merr. POMELO
——*medica* L. CITRON
——*miaray* West. MIARAY
——*mitis* Blanco. KALAMONDIN
——*nobilis* Lour. MANDARIN
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——*sinensis* Osb. ORANGE
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Cocos mucifera L. COCONUT
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——*arabica* L. COFFEE-ARABIAN
——*canephora* Pierre. COFFEE-CANEPHORA
——*congensis* Froehn. COFFEE-CONGO
——*excelsa* Cheval. COFFEE-EXCELSA
——*liberica* Hiern. COFFEE-LIBERIAN
——*quillou.* COFFEE-QUILLOU
——*robusta* L. Linden. COFFEE-ROBUSTA
——*ugandæ.* COFFEE-UGANDA
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Cucumis melo L. MUSKMELON
Cudrania tricuspidata Bu. CHESANG
Cynometra cauliflora L. LAMÚTA
Cyphomandra calycina Sendt. CYNDRA
Dillenia indica L. HONDAPARA
——*megalantha* Merr. BAYANI
——*philippinensis* Rolfe. KATMON
——*reifferscheidia* F. Vill. PALALI
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——*ebenaster* Retz. ZAPOTE
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——*calubcub* C. B. R. ADANG
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——*curanii* C. B. R. LIPOTI
——*dombeyi* Skeels. GRUMICHAMA
——*edulis.* ARGENA
——*garciæ* Merr. IGANG
——*javanica* L. MAKOPA
——*malaccensis* L. TERSANA
——*mananquil* Blanco. MANKIL
——*polycephaloides* C. B. R. MAIGANG
——sp. ARAHIS
——sp. BALAUSAN
——sp. INOGUG
——*uniflora* L. PITANGA
——*xanthophylla* C. B. R. LAPINI
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——*longana* Lam. LONGAN
——*nephelioides* Radlk. ALUAO
Feijoa sellowiana Berg. FEIJOA
Feronia limonia Swg. VILATTI
Ficus carica L. FIG
——*sycomorus* L. SYKAMORE
Flacourtia cataphracta Roxb. PANIALA
——*inermis* Roxb. LOUVI
——*ramontchi* l'Her. SERÁLI
——*rukam* Zoll. et. M. RUKAM
——*sepiaria* Roxb. BITUNGOL
——*sulcata* Elm. LANAGON
Fortunella japonica Swg. KUMQUAT
Fragraria chiloensis Duch. STRAWBERRY
Garcinia benthami Pierre. BUNAG
——*binucao* Choicy. BINUKAO
——*cumingiana* Pierre. MALABU
——*dives* Pierre. PILDIS
——*dulcis* Kurz. BANITI
——*lateriflora* Bl. KARIIS
——*mangostana* L. MANGOSTEEN
——*pinnatinervia* Elm. PEPI
——*rubra* Merr. KAMANI
——*samarensis* Merr. TAGKÓN
——*subelliptica* Merr. DANEALAN
——*sulphurea* Elm. BATUÁN
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——*venulosa* Choisy KATURI
——*vidallii* Merr. ANTÓL
——sp. KABANGLA
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——*indicum* L. BULSO
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Grewia asiatica L. PHALSA
——*edulis* Merr. BALUKO
——*stylocarpa* Warb. MULING
Hibiscus sabdariffa L. ROSELLE
Ilex paraguariensis St. Hil. MATÉ
Inocarpus edulis Forst. KAYAM
Lansium domesticum Jack. LANZON
——*domesticum* Jack. var. *duku*. DUKU
——*dubium* Merr. MAMATA
Licania platypus Fritsch. SANSAPOTE
Litchi chinensis Sonn. LITCHI
——*philippinensis* Radlk. KAMINGI
Lucuma nervosa A. DC. CANISTEL
——*salicifolia* H. B. K. BORACHO
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Mammea americana L. MAMEY
Mangifera altissima Blanco. PÁHO
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——*indica* L. MANGO
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Mimusops elengi L. KABIKI
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Morus alba L. MULBERRY
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——*mutabile* Bl. BULALA
Palaquium philippense C. B. R. ALAKAO
Pangium edule Reinw. PANGI
Passiflora edulis Sims. LILIKOI
——*laurifolia* L. PARCHA
——*quadrangularis* L. GRANADILLA
Pereskia aculeata Mill. PERESKIA
Persea americana Mill. AVOCADO
Phoenix dactylifera L. DATE
Phyllanthus acidus Skeels. IBA
——*emblica* L. NELLI.
Physalis peruviana L. POHA
Piper nigrum L. PEPPER
Pithecolobium dulce Benth. KAMANCHILE
Prunus persica Sieb. et Zucc. PEACH
Psidium cattleianum Sabine. CATTLEY
——*friedrichsthalianum* Ndz. COS
——*guajava* L. GUAVA
——*guineense* Sw. ARACA
——*laurifolium* Berg. LAURIVA
——*molle* Bertol. GUISARO
Punica granatum L. POMEGRANATE
Pyrus malus L. APPLE
Rheedia edulis Planch. et Triana. BERBA
——*madrono* Planch. et Triana. MADRONO
Rollinia emarginata Schlecht. MIRIM
——*orthopetala* A. DC. BIRIBA
——sp. PINHO
Rubus copelandii Merr. COPELA
——*betulaefolius* Small. NORTHEYBERRY
——*ellipticus* Sm. TITAO
——*elmeri* Focke. TIBAO
——*fraxinifolius* Poir. PALANAU
——*moluccanus* L. KINUBO
——*nigrobaccus* Bly. BLACKBERRY
——*niveus* Thunb. PILAY
——*pectinellus* Max. ATÍBU
——*rolfei* Vid. ROLFEIA
——*rosæfolius* Sm. RAGINI
——sp. LOGANBERRY
Sandoricum koetjape Merr. SANTOL
——*radiatum* King. KECHAPI

Sapindaceæ. AGLAÑO
Sarcocephalus esculentus Afzel. CEFALUS
Saurauia bontocensis Merr. DUGUAY
——*reticulata* Merr. KARIMUG
Semecarpus cuneiformis Blanco. KAMIRING
——*gigantifolia* F. Vill. MANALU
Sideroxylon mastichodendron Jacq. MASTIC
Spondias cytherea Sonn. HEVI
——*lutea* L. MOMBIN
——*pinnata* Kurz. LANNO
——*purpurea* L. CIRUELA
——*tuberosa* Arr. IMBU
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Thea sinensis L. TEA
Theobroma cacao L. CACAO
Triphasia trifolia P. Wils. LIMONCITO
Uvaria rufa Bl. BANAUAK
——*sorsogonensis* Presl. ALAGA
Vaccinium villarii Vid. ALEMANI
——*whitfordii* Merr. KOTMO
Vangueria madagascariensis J. F. Gmel. VOAVANGA
Vanilla planifolia Ans. VANILLA
Vitis rotundifolia Michx. GRAPE-MUSCADINE
——*vinifera* L. GRAPE-VINIFERA
Ximenia americana L. BUOL
Zalacca edulis Reinw. SALAK
Zinziber officinale Rosc. GINGER
Ziziphus jujuba L. JUJUBE

TABLE SHOWING THE NUMBER OF PLANTS, SET AT GIVEN DISTANCES, REQUIRED FOR ONE HECTARE

Distance in meters	Number of plants	Distance in meters	Number of plants	Distance in meters	Number of plants
0.3×1.2	27,777	3×4	833	8×8	156
0.3×1.5	22,222	3×5	666	8×9	139
0.4×1.2	20,833	4×4	625	8×10	125
0.5×1	20,000	3×6	555	9×9	123
0.4×1.5	16,666	4×5	500	9×10	111
0.5×1.2	16,666	4×6	416	10×10	100
0.6×1.2	13,888	5×5	400	10×12	83
0.5×1.5	13,333	4×7	357	11×11	83
0.6×1.5	11,111	5×6	333	12×12	70
0.75×1.2	11,111	4×8	312	13×13	59
1×1	10,000	5×7	285	14×14	51
0.75×1.5	8,888	6×6	277	15×15	44
1×1.5	6,666	5×8	250	16×16	39
1×2	5,000	6×7	238	17×17	34
1×3	3,333	5×9	222	18×18	30
2×2	2,500	6×8	208	19×19	27
2×3	1,666	7×7	204	20×20	25
2×4	1,250	5×10	200		
3×3	1,111	7×8	178		

To find the number of plants required for one hectare, multiply the distances in meters at which the plants are to stand apart each way and divide 10,000 by the product; the quotient will be the number of plants required. For instance, a field is to be set out to trees 8 meters apart; (8 × 8 = 64; 10,000 ÷ 64 = 156) thus 156 trees would be required to the hectare.

PLANTING TABLE FOR TROPICAL FRUITS

NOTE.—In conjunction with a consultation of this table read the first paragraphs under "Staking and Planting," page 79.

Popular names.	Spacing in variety orchard, meters.	Spacing in ordinary orchard practice, meters.
Alpay	8	7 - 9
Anigli	8	7 - 9
Atemoya	8	7 - 8
Avocado	12	9 -12
Bael	8	8 - 9
Bageja	15	12 -15
Banago	8	8 - 9
Banana		3.5- 4.5
Banauak	8	5.5- 7
Baniti	8	8 -10
Baobab	15	12 -18
Barobo	12	9 -12
Bauno	15	12 -18
Berba	8	8 -10
Bignay	5	5 - 7
Binukao	8	6 - 8
Biriba	8	7 - 9
Bobonao	8	7 - 8
Brazil nut	15	14 -18
Breadfruit	12	10 -14
Bulala	12	10 -14
Burung	8	7 - 9
Cacao	5	3.5- 5
Caimitillo	12	10 -12
Caimito	12	10 -14
Carambola	5	4 - 6
Carob	8	8 -10
Cashew	12	8 -12
Cattley	5	5 - 6
Cefalus	8	7 - 9
Ceriman—Plant in partial shade near a post on which to climb		3.5- 4
Cherimoya	8	7 - 8
Chico	8	7 -10
Chico Mamey	12	9 -12
Ciruela	12	10 -12
Citron	5	4 - 5.5
Coconut		8 -10
Coffee, Abeota		3.4- 4
Coffee, Arabian		2 - 2.5
Coffee, Dybo		3.4- 4
Coffee, Excelsa		3.4- 4
Coffee, Canefora		2.1- 2.7
Coffee, Congo		2.1- 2.7
Coffee, Liberian		3.4- 4
Coffee, Quillou		2.7- 3
Coffee, Robusta		2.1- 2.7
Coffee, Uganda		2.1- 2.7
Corica	12	9 -12
Cos	8	8 - 9
Custardapple	8	6 - 9
Cyndra	5	4 - 6
Dalinsi	15	15 -18
Date	8	6 - 7.5
Duhat	15	12 -18
Duku	8	6.5- 8.5
Durian	15	12 -18
Gandaria	15	11 -14
Genipa	12	10 -12
Granadilla—Train on trellis or overhead		3 - 5
Grape—Train on trellis overhead		6
Grumichama	8	7 - 9
Guanabano	8	5 - 8
Guava	8	7 - 9

Planting table for tropical fruits—Continued.

Popular names.	Spacing in variety orchard, meters.	Spacing in ordinary orchard practice, meters.
Hevi	15	12 -18
Hondapara	12	10 -12
Huani	15	12 -15
Iba	8	6.5- 8
Icaco	5	5 - 7
Jak	8	8 -10
Kalamondin	5	4 - 5
Kalapi—Plant beside a tree for support		
Kalpi	8	6 - 8
Kamanchile	12	8 -12
Kamia	8	4.5- 7
Kanari	12	12 -15
Karanda	8	6 - 8
Katmon	12	9 -12
Kayam	15	10 -15
Ketembilla	8	7 - 9
Kledang	8	9 -10
Kubili	8	8 - 9
Kuching	8	8 -10
Lamuta	8	8 -10
Lanzon	8	7 - 9
Lauriva	8	6 - 8
Lemasa	8	7 - 9
Lemon	8	7 - 8.5
Lilikoi—Plant near an arbor for support		5
Lime	5	5 - 6
Limon Real	8	7.5-10
Litchi	12	9 -12.5
Litoko—Plant near a large tree for support		
Lipoti	8	8 -10
Longan	8	7 -10
Loquat	5	4.5- 5.5
Mabolo	12	10 -18
Makopa	8	6 - 7.5
Mandalika	12	9 -11
Mandarin	8	6 - 7.5
Mango	15	12 -18
Mangosteen	8	7 -10
Marang	15	12 -16
Mirim	5	5 - 7
Mombin	15	12 -15
Mulberry	12	10 -12
Orange	8	7 - 9
Palali	12	10 -15
Paniala	8	8 -10
Papaya	5	3.5- 4
Parcha—For arbor over doorway or on trellis		5 - 6
Pereskia—Train on arbor over doorway or on trellis		3 - 4
Phalsa	12	10 -12
Pili	12	11 -14
Pinho	8	6 - 8
Pineapple—60 to 75 centimeters apart, in beds of 2 to 8 rows abreast; or in rows 1 to 1.3 meters apart		
Pitanga	5	5 - 7
Pomelo	8	8 - 9.5
Rambi	12	10 -14
Rambutan	12	10 -14
Rima	12	10 -14
Roselle		1.5- 2.5
Rukam	8	8 - 9
Salak	5	5 - 7
Sansapote	15	12 -15
Santol	15	12 -15
Serali	8	7 - 9
Soncoya	8	7 - 9
Sour orange	8	7 - 9
Sugarapple	5	4.5- 6
Tamarind	15	12 -18
Tamisan	8	5.5- 8
Tersana	8	8 -10
Tizon	8	6 - 8
Tungulu	5	2.5- 3.5
Uvero	12	11-14
Voavanga	8	6-8
Wampi	5	5 - 7
Yambo	12	10 -12
Yaruma	12	9 -12
Zapote	12	10 -14

TABLES OF WEIGHTS AND MEASURES

Metric units and their equivalents in common measures.

LENGTH

Metric units	Meters	Common measures
1 hectometer	100	328.083 feet
1 decameter	10	32.808 feet
1 meter	1	3.281 feet (39.37 inches)
1 decimeter	.1	3.937 inches
1 centimeter	.01	0.394 inch
1 millimeter	.001	0.039 inch

AREA

Metric units	Square meters	Common measures
1 hectare	10,000	2.471 acres
1 are	100	119.59 square yards
1 centare	1	1,550.016 square inches

CAPACITY

Metric units.	Liters	Common measures
1 hectoliter	100	26.417 gallons
1 decaliter	10	2.6417 gallons
1 liter	1	1.0567 quarts (liquid)
1 deciliter	.1	0.845 gill
1 centiliter	.01	0.352 fluid ounce
1 milliliter	.001	0.27 fluid dram

WEIGHT

Metric units	Grams	Common measures
1 metric ton	1,000,000	2,204.62 pounds, Avoir.
1 kilogram	1,000	2.205 pounds, Avoir.
1 hectogram	100	3.527 ounces, Avoir.
1 decagram	10	0.353 ounce, Avoir.
1 gram	1	15.432 grains, Troy

Common measures and their equivalents in metric units.

LENGTH

Common measures	Metric units
1 mile	1,609.35 meters
1 chain	20.12 meters
1 rod	5.03 meters
1 yard	0.91 meters
1 foot	0.30 meters
1 inch	0.0254 meters

Tables of weights and measures—Continued

AREA

Common measures	Metric units
1 acre	0.4047 hectare
1 square rod	25.29 square meters
1 square yard	0.836 square meter
1 square foot	0.0929 square meter
1 square inch	6.452 square centimeters

CAPACITY

Common measures	Metric units
1 cubic yard	0.765 cubic meter
1 cubic feet	0.028316 cubic meter
1 bushel	35.239 liters
1 peck	8.810 liters
1 gallon	3.78543 liters
1 quart (dry)	1.101 liters
1 quart (liquid)	0.94636 liter
1 pint (liquid)	0.47318 liter
1 gill	0.11839 liter

WEIGHT

Common measures	Metric units
1 long hundred weight (112 pounds or $\frac{1}{20}$ long ton)	50.802 kilograms
1 pound, Avoirdupois	453.59 grams
1 ounce, Avoirdupois	28.35 grams
1 ounce, Troy	31.10 grams

ADDENDA

The information below, based on experimental work in progress at the Lamao Experiment Station while this bulletin was in press, was obtained too late for insertion in the chapter where it belongs, p. 64.

Antol. *Garcinia vidalii.* Use mature, green, smooth, nonpetioled budwood; cut the bud 4 to 5 centimeters long; insert the bud in the stock at a point of the same appearance as the scion or at most streaked with gray.

Ayó. *Tetrastigma harmandi.* Propagated from cuttings 20 to 25 centimeters long, made from well matured, rough vines from which the green color has disappeared, inserted diagonally in sand or sandy soil during the early part of the hot, dry season.

Bael. *Belou marmelos.* Can be propagated from root cuttings, 20 to 25 centimeters long, 1 to 4 centimeters in diameter, inserted diagonally in sand during the early part of the hot, dry season.

Baniti. *Garcinia dulcis.* Use mature, green, smooth, nonpetioled budwood; cut the bud 3.5 to 4 centimeters long; insert the bud in the stock at a point of the same appearance as the scion or at most where the bark is streaked with gray.

Binukao. *Garcinia binucao.* Cleftgrafted without difficulty. Cut preferably nonpetioled scions, 6 to 8 centimeters long, from well mature, green and smooth to rough and brownish growths; insert in stock 6 to 10 centimeters above ground when at the point of union not more than 15 millimeters in diameter.

Has been shieldbudded at the Lamao Experiment Station.

Bitungol. *Flacourtia sepiaria.* Use petioled, well mature, brown budwood; cut the bud 3 centimeters long; age of stock at point of insertion unimportant.

Ciruela. *Spondias purpurea.* Easily cleftgrafted and grows well on the Lanno. Use nonpetioled scions 8 to 10 centimeters long, of last years growth, from which the green color has disappeared; insert in stock about 10 centimeters above the ground when mature, but not more than 2 centimeters in diameter at the point of union.

Imbu. *Spondias tuberosa.* Cleftgrafted without difficulty and grows well on the Lanno. Cut nonpetioled scions, 7 to 10 centimeters long, from well matured growth made the previous season, from which the green color has disappeared; insert in stock preferably about 10 centimeters above the ground when mature but not more than 2 centimeters in diameter at the point of union.

Pitanga. *Eugenia uniflora.* Easily cleftgrafted during the hot, dry season. Cut scions 5 to 7.5 centimeters long, from mature, brownish twigs; insert in stock not more than 10 millimeters in diameter, nor more than 10 centimeters above the ground.

Uvero. *Coccoloba uvifera.* Easily propagated from hardwood cuttings 25 centimeters long, made from well ripened branches from which all green color has disappeared, inserted diagonally in sand during November to January.

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